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TO

THE

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HAND-BOOK

TO THE

LOCAL MARINE BOARD

EXAMINATION,

FOR

THE OFFICERS

OF THE

BRITISH MERCANTILE MARINE.

PREFACE.

IT being now incumbent on all officers of the British Mercantile Marine to pass an Examination before the Local Marine Board, in order to test their efficiency for their respective grades, the following pages will be found to contain such portions of the Examination as are required, independent of seamanship, which can only be obtained by service at sea.

In the answers to the questions in Navigation, it has been thought sufficient to give only the more prominent portions of the solution, thereby leaving the student to do something for himself, by studying the rules in the Epitome, and endeavouring to fully understand the use of the Tables, especially Logarithms. If properly and accurately worked out, the answers should not deviate in any case, more than from 5" to 10" from those given, such difference arising from the dip and refraction tables which the student may use. It cannot be too deeply impressed on all, that an accurate knowledge of Time is essentially requisite, without which no question in Nautical Astronomy can be correctly solved.

The article on "Storms" has been written by Mr. W. R. Birt, and will be found to contain valuable information on the subject.

In the latter portion of the work will be found the instructions for Stowing Cargo, as recommended by Lloyd's.

In respect to Charter-party, Bills of Lading, Bottomry

Bonds, &c. it has been the object merely to give a general knowledge of the subjects, and to indicate what is required in them ; for the entire description and requirements of such documents cannot be given in brief, in such a manner as to make the young Master fully acquainted with them, as condensation of such matter frequently involves obscurity ; and it is encumbent on every Master to understand thoroughly the Law of Shipping, for which purpose reference must be made to the Works of ABBOT, LEES, McCULLOCH, and STEEL.

CONTENTS.

NOTICE

OF

EXAMINATIONS OF MASTERS AND MATES,

Established in pursuance of the Mercantile Marine Act, 1850,

AND OF

VOLUNTARY EXAMINATIONS IN STEAM,

To come into operation on the 1st September, 1852.

No *Foreign-going vessel is permited to clear out from any custom house in the United Kingdom, unless the masters and mates respectively are in possession of Certificates, either of Service or of Competency.

The Certificate of service entitles an officer, who has already served as either master or mate in the British merchant service before the 1st January, 1851, to go in those capacities again, and may be had by application to the Registrar-General of Seamen, Custom House, London, on the transmission of the necessary certificates and testimonials.

Certificates of competency will be granted by the Board of Trade, to all mates and masters who have passed examinations, whether under the old or the present regulations, and also to all officers who have passed Lieutenants, Masters, and Second Masters examinations in the Royal Navy and East India Company's service, unless special reasons to the contrary exist; and any person desirous of changing a passing certificate—obtained under the former Boards of Examiners—for a Certificate of Competency, should send it to the Registrar-General, as before

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*By a Foreign-going vessel is meant one which is bound to some place out of the United Kingdom, beyond the limits included between the River Elbe and Brest.

mentioned, with a request to that effect, and state the port to which he wishes it to be sent, where it will be delivered to him by the Collector of Customs or the Shipping Master.

All other officers, entering for the first time upon their duties, whether as mate or master, will be required to undergo an examination before one of the Local Marine Boards before they can act in either of those capacities.

The examinations required for qualification for the several ranks under mentioned, are as follow :—

A SECOND MATE must be seventeen years of age, and must have been four years at sea.

IN NAVIGATION.—He must write a legible hand, and understand the four first rules of arithmetic, and the use of logarithms. He must be able to correct the courses steered for variation and leeway, and find the difference of latitude and longitude therefrom ; be able to correct the sun's declination for longitude, and find his latitude by meridian altitude of the sun ; and work such other easy problems of a like nature as may be put to him. He must understand the use of the sextant, and be able to observe with it, and read off the arc.

IN SEAMANSHIP.—He must give satisfactory answers as to the rigging and unrigging of ships, stowing of holds, &c. ; must understand the measurement of the log-line, glass, and lead-line ; be conversant with the rule of the road, as regards both steamers and sailing-vessels, and the lights carried by them.

An ONLY MATE must be eighteen years of age, and have been four years at sea.

IN NAVIGATION.—In addition to the qualification required for a Second Mate, an Only Mate must be able to work a day's work complete, including the bearing and distance of the port he is bound to by Mercator's method. He must be able to observe, and calculate the amplitude of the sun, and deduce the variation of the compass therefrom. He must know how to lay off the place of the ship on the chart, both by bearings of known objects, and by latitude and latitude. He must be

able to use a sextant and determine its error, and adjust it, and find the time of high water from the known time at full and change.

IN SEAMANSHIP.—In addition to what is required by a Second Mate, he must know how to moor and unmoor, and to keep a clear anchor ; to carry out an anchor; to stow a hold; and to make the requisite entries in the ship's log.

A FIRST MATE must be nineteen years of age, and have served five years at sea, of which one year must have been as either Second or Only Mate, or as both.*

IN NAVIGATION.—In addition to the qualification required for an Only Mate, he must be able to observe azimuths and compute the variation; to compare chronometers and keep their rates, and find the longitude by them from an observation by the sun; to work the latitude by single altitude of the sun, off the meridian ; and be able to use and adjust the sextant by the sun.

IN SEAMANSHIP.—In addition to the qualification required for an Only Mate, a more extensive knowledge of seamanship will be required, as to shifting large spars and sails, managing a ship in stormy weather, taking in and making sail, shifting yards and masts, &c., and getting cargo in and out ; and especially heavy spars and weights, anchors, &c. ; casting ship on a lee-shore ; and securing the masts in the event of accident to the bowsprit.

A MASTER must be twenty-one years of age, and have been six years at sea, of which one year must have been as First or Only Mate, and one year as Second Mate; or two years as First and Only Mate.*

In addition to the qualification for a First Mate, he must be able to find the latitude by a star, &c. He will be inquired

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* Service in a superior capacity is in all cases to be equivalent to service in an inferior capacity.

of as to the nature of the attraction of the ship's iron upon the compass, and as to the method of determining it. He must possess a sufficient knowledge of what he is required to do by law, as to entry and discharge, and the management of his crew; as to penalties and entries to be made in the official log. He will be questioned as to his knowledge of invoices, charter-party, Lloyd's agent, and as to the nature of bottomry, and he must be acquainted with the leading lights of the channel he has been accustomed to navigate, or which he is going to use.

In cases where an applicant for a certificate as master ordinary has only served in a fore and aft rigged vessel, and is ignorant of the management of a square rigged vessel, he may obtain a certificate on which the words "*fore and aft rigged vessel,*" will be written. This is not, however, to apply to Mates, who, being younger men, are expected for the future to learn their business completely.

An EXTRA MASTER'S EXAMINATION is intended for such persons as are desirous of obtaining command of ships and steamers of the *First Class.* Before being examined for an Extra Master's Certificate, an applicant must have served one year either as a Master with an *ordinary Certificate of Competency,* or as a Master having a *First Class Certificate,* granted by one of the former Boards of Examiners.

IN NAVIGATION.—As such vessels frequently make long voyages, to the East Indies, and the Pacific, &c. the candidates will be required to work a lunar observation by both sun and star, to determine the latitude by the moon and star, by Polar star off the meridian, and also by double altitude of the sun, and to verify the result by Sumner's method. He must be able to calculate the altitudes of the sun or star, when they cannot be observed, for the purposes of lunars, also to find the error of a watch, by the method of equal altitudes. To correct the altitudes observed with an artificial horizon.

He must understand how to observe and apply the deviation of the compass; and to deduce the set and rate of the

current from the D. R. and observation. He will be required to explain the nature of great circle sailing, and know how to apply practically that knowledge; but he will not be required to go into the calculations. He must be acquainted with the law of storms, so far as to know how he may probably best escape those tempests common to the East and West Indies, and known as hurricanes.

IN SEAMANSHIP.—The extra examination will consist of an inquiry into the competency of the party to heave a ship down, in case of accident befalling her abroad; to get lower masts and other heavy weights in and out; how to construct rafts, and as to his resources for the preservation of the ship's crew, in the event of wreck, and in such operations of a like nature as the examiner may consider necessary.

The candidates will be allowed to work out the various problems according to the method and the tables they have been accustomed to use, and will be allowed five hours to perform the work; at the expiration of which, if they have not finished, they will be declared to have failed, unless the Local Marine Board see fit to extend the time.

Applicants for examination are required to give their names to the Shipping Master or to the Local Marine Board, at the place where they intend to be examined, on or before the day of examination, and to conform to the regulations in this respect which may be laid down by the Local Marine Board; and if this be not done, a delay will be occasioned.

The examinations will commence early in the forenoon and be continued from day to day, until all the candidates, whose names appeared upon the Shipping Master's list on the day of examination are examined.

Testimonials of character, sobriety, and trust-worthiness will be required of all applicants, and without which no person will be examined; and as testimonials may have to be forward-ed to the office of the Registrar General of Seamen in London, for verification, before any certificates can be granted, it is de-

sirable that candidates should lodge them as early as possible. Upon application to the Shipping Master, candidates will be supplied with a form, which they will be required to fill up and lodge with their testimonials in the hands of the Examiners.

The fee for examination must be paid to the Shipping Master. If a candidate fail in his examination, half the fee he has paid will be returned to him by the Shipping Master, on his producing a document which will be given him by the Examiner.

The following are the fees to be paid by applicants for examination:—

Second Mate..................................	£1	0	0
First and Only Mate, if previously possessing an inferior certificate............	0	10	0
If not	1	0	0
Master, whether Extra or Ordinary ...	2	0	0

Any one who has been one year in possession of a Master's first-class Certificate, granted by one of the former Boards of Examiners, or of an Ordinary Master's Certificate of Competency granted under the present Examiners, may pass an Extra Examination, and receive an Extra Certificate in exchange for his former one, without payment of any fee; but if he fails in his first examination, he must pay half a Master's fee on his coming a second time; and the same sum for every subsequent attempt.

If the applicant passes he will receive a document from the Examiner, which will entitle him to receive his Certificate of Competency from the Shipping Master at the port to which he has directed it to be forwarded. If his testimonials have been sent to the Registrar to be verified, they will be returned with his certificate.

If an applicant is examined for a higher rank and fails, but passes an examination of a lower grade, he may receive a Certificate accordingly, but no part of the fee will be returned.

As the examinations of Masters and Mates are made com-

pulsory, the qualifications have been kept as low as possible ; but it must be distinctly understood, that it is the intention of the Board of Trade to raise the standard from time to time, whenever, as will no doubt be the case, the general attainments of officers in the merchant service shall render it possible to do so without inconvenience ; and officers are strongly urged to employ their leisure hours, when in port, in the acquirement of the knowledge necessary to enable them to pass their examinations ; and Masters will do well to permit apprentices and junior officers to attend schools of instruction, and to afford them as much time for this purpose as possible.

EXAMINATIONS IN STEAM.

Arrangements have been made for giving to those Masters, or applicants for Masters Certificates, who desire to do so, an opportunity of undergoing an examination as to their practical knowledge of the use and working of the steam engine. These examinations will be conducted under the superintendence of the Local Marine Boards, at such times as they may appoint for the purpose; and the Examiners will be selected by the Board of Trade from the engineer surveyors appointed under the Steam Navigation Act.

The examination will not comprise intricate theoretical questions, but will be such as to satisfy the Examiner that the applicant is competent to control the working of the engine, and has such a knowledge of the ordinary parts of the machinery, as will enable him to judge of the nature of an accident, and, in the absence of the engineer, to give the necessary directions in the engine room.

The practice will be as follows :—The applicant must deliver to the Shipping Master a statement in writing to the effect that he wishes to be examined in Steam. If he is about to pass a master's examination in navigation also, this statement must be on or annexed to the form E E; if he has a Master's Certi-

ficate of Competency, it must be delivered to the Shipping-Master with his Certificate, so that due notice may be given to the Examiner, and so that the Board of Trade on receiving it may have the means of indorsing on his Certificate, and recording the fact that he has passed in Steam. He must also, at the same time, pay a fee of 7s., which will be applied in remunerating the Examiners. Notice will be given of the time at which the applicant is to attend to be examined; and if he passes, the result of the examination will be reported to the Board of Trade, and his Certificate of Competency will be issued or returned to him, as the case may be, with an indorsement as above mentioned, showing that he has passed in Steam. If he fails, no notice of the failure will be recorded on the Certificate, but no part of the fee will be returned.

<div style="text-align:right">F. W. BEECHEY.
W. H. WALKER.</div>

T. H. FARRER,
    Secretary.

Naval Department, Board of Trade,
    May, 1852.

Exercises in Logarithms, &c. for Second Mates.

1. Required the logarithm of the following numbers,—

6754	7200	43710	39906	400000
·1463	·00647	3·874	18·006	·0046

2, Find the number corresponding to the following logarithms,—

0.768432	0·821567	2·374900	2.610432	4·000710
1·874216	1·914000	3·100300	3.214797	5·001476

3. Find the log. sine of

47°	30'	52″	170°	30'	39″	1°	49'	47″
72	4	25	110	11	I8	1	0	40

Find the log co-sine of

36	7	21	88	40	56		88	59	19
20	8	40	30	0	50	and	108	40	6

Find the log tangent of

22	20	11	1	8	7		52	10	46
37	9	41	1	2	18	and	114	9	30

4. Find the log co-tangent of

38	50	19	58	43	37		71	43	6
64	10	40	9	8	39	and	3	7	4

Find the log secant of

20	30	15	45	10	19		71	43	6
29	11	40	101	8	7	and	38	7	4

Find the log co-secant of

45	8	29	70	30	24		141	16	51
127	30	40	60	11	9	and	16	0	20

5. Find the arc to the log. sine of

9·180641	9·990640	8·462167	8·846217

co-sine of

9·344178	9·983862	9·876419	8·967391

tangent of

9·642876	10·846215	9·846175	10·060431

co-tangent of

9·742691	10·876432	9·374611	8·460000

secant of

10·034687	10·090188	11·546718	11·200000

co-secant of

10·109761	10·061462	11·467931	11·000873

6.   Multiply 476 by 682 by logs.

7.   Multiply ·3746 by ·6168 by logs. and decimals.

8.   Find the product of 38, 1·74, 96, and ·0756, by logs.

9.   Find the product of 376, ·0069, and 1·476 by logs.

10. Find the product of 2·4, .008, ·62 and 3·1.

11. Divide 87469 by 364 by logs.

12. Divide 37 by ·02 by logs. and decimals.

13. Divide 76 by 874 by logs.

14. Divide 10 by 5·86 by logs. and decimals.

15. Divide 6748 by ·00763 by logs.

16. Divide ·34761 by 2.674 by logs. and decimals.

17. Required the square of 46, of 94, of ·163 and of ·0075 by logs.

18. Required the cube of 47, of 63, of ·109 and of ·C3861 by logs.

19. Required the square root of 4796, of 746937 and of ·6470, by logs.

20. Required the cube root of 36472, of 62154 and of ·7564 by logs.

21. What is the cost 243 yards at 9s. 3¾d. per yard, by logs. and decimals.

22. What is the cost of 3 tons 2 cwt. 3 qrs. at 4s, 6d. for 7 lbs. by logs.

23. If 100 yards cost £70. 15s. what does 1 foot cost at the same rate?

24. If ⅞ of a lb. cost 4s. 8½d. what will 27$\frac{9}{10}$ lbs. cost?

ON TIME.

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TIME being a measured portion of infinite duration, any
event which recurs at equal intervals, might be taken as the
unit of admeasurement, and to this end, nothing seems more
appropriate, than that the required standard should be sought
among the innumerable celestial orbs, which appear to be
continually revolving around our Earth.

Numberless observations, made in different ages of the
world, have proved that the time intervening between two
consecutive passages of the same star over a given meridian,
is uniform and unchanging. Here, then, we have a stan-
dard more exact than any that could be devised by art.
Owing, however, to the elipticity of the earth's orbit, and
the plane of the equator not being coincident with that of the
ecliptic, this measure of time, (called by astronomers the
sidereal day,) which is wholly uninfluenced by such pheno-
mena, does not agree with the interval measured by the ap-
parent revolution of the Sun around our earth; and since,
if it had been adopted as the unit of admeasurement, the day
(by which term is understood a certain fixed and uniform pe-
riod of time,) would have commenced at no regular instant,
as regards the rising, setting, or meridian transit of that
luminary, which is at once the centre of our system and the
source of light and heat; it seems therefore not only more
natural, but certainly more convenient for the ordinary pur-
poses of life, that the "working day" should be regulated
by the Sun.

1

Now the *true solar,* or *apparent* day, which is measured
by two successive passages of the sun over the meridian of
any place on the earth's surface, is a variable quantity; but
there is a regular succession of its variations, which in a cer-
tain period, termed a year, come to an end, to be commenced
anew.   In order, therefore, to obtain a convenient and
equable measure of time, astronomers assume a *mean solar
day,* the length of which is equal to the average of all the
apparent solar days in a year.

The interval by which the apparent is in excess or falls
short of the mean day, constitutes the *equation of time;* this
difference is greatest about the 3rd of November, and four
times in a year, viz. April 15, June 15, September 15, and
December 24, it vanishes, or is exceedingly small.

We next notice two methods of *commencing* the day,
which unless fully understood, must be productive of very
considerable error in working the various questions which
arise in Nautical Astronomy.

1. The *astronomical day* begins at *noon,* and its minor
divisions are reckoned from that instant, or 0^h 0^m 0^r to 24^h,
continuously.

2. The *civil day,* which is the one used in reference to
the ordinary transactions of life, commences at *midnight* and
precedes the astronomical day by 12 hours, but its minor
divisions are *not* counted *successively* to 24 hours; the interval
from midnight to noon being styled A.M., and that from noon
to midnight again P.M., each reckoned to 12 hours: hence it
follows that from noon to midnight, the day of the month
and the hour of the day are the same in both methods; but
from midnight to noon they differ.

In illustration, turn to the Nautical Almanac for the year
1854, page 564; at the top of the first column, under January,
is found 1^d 2^h 7^m $\odot$ in perigee ; this is in astronomical time,

and coincides with January 1st, 2^h 7^m P.M. civil time. The next phenomenon on the same page is marked thus, in astronomical time, 1^d 23^h 53^m ♀ ☌ ☾, which expressed in civil time, would be January 2nd, 11^h 53^m A.M. So in like manner, a morning observation of a celestial object, made under any meridian, say March 20, (civil time) at 8^h 40^m A.M. would be represented astronomically thus, March 19^d 20^h 40^m; while another observation made on the same day, but in the evening, as thus, March 20 (civil time) at 4^h 20^mP.M. is expressed in astronomical time, March 20^d 4^h 20^m; and the application of the longitude in time, (by addition if westerly, by subtraction if easterly,) to the given or estimated time of observation, will be the corresponding Greenwich time.

Since all the elements of the heavenly bodies given in the Nautical Almanac, bear reference to the *astronomical day*, its relation to the civil mode of reckoning must never be lost sight of; for unless the true *Greenwich astronomical date* be known at the time an observation is made to determine latitude, longitude, or variation of the compass, it is impossible that the solution of the question can be correct.

The sidereal day, to which we have already referred, consists of 23^h 56^m $4\cdot09^s$ mean solar time. In the determination of certain elements by means of a Planet, the Moon, or a Fixed Star, the operation is somewhat shortened, by a knowledge of sidereal time.

We have made these remarks, solely to impress on Navigators the importance of making themselves perfectly acquainted with *time*, which can be done by a careful perusal of the "Epitomes," and the "Explanations," at the end of the Nautical Almanac.

DAY'S WORKS.

H.	K.	$\frac{1}{10}$	Courses.	Winds.	Lee way.	Remarks.
1						P.M.
2	4	4	W. by S·	S. by W.	0	I take my departure from a point of land
3	5	6				in lat. 25° 39′ S. long 45° 2′ E. bear-
4	5	6	S.E. by S.	S.W. by S.	¼	ing by compass N.W. by N.¼N. distant
5	6	6				21 miles.
6	7	6				
7	8	2				
8	7	6	S.S.E.	S.W.	1	
9	7	4				
10	6	4				
11	6	6				
12	7	0				A.M.
1	7	0	S.W. by W.	S.E.	½	
2	7	0				
3	7	0				A current set the ship S.W.byS. by com-
4	7	4				pass, at the rate of 4 miles an hour,
5	6	6				during the last 8 hours.
6	6	0	S.S.W.¼W.	E. by N.	0	
7	6	0				
8	5	5				
9	6	5				
10	6	0	N.W.¼W.		0	
11	6	5				
12	7	5				Variation 2 pts. W.

H.	K.	$\frac{1}{10}$	Courses.	Winds,	Lee way.	Remarks.
1						P.M. I take my departure from a point
2	3	4	S.S.E.	S.W.	1	of land, bearing by compass S.W. dis-
3	3	6				tance 18 miles, in lat. 37°35′S. long.
4	4	0				150° 5′ E.
5	6	2	W.N.W.	ditto	1¼	
6	4	4				
7	5	4				
8	6	4				
9	4	6				
10	2	4	W. by N	S.W.b.S.	2	
11	5	0				
12	4	4				
1	4	6				A.M.
2	5	6				
3	5	4	S.b.E.¾E.	S.W.	1¼	
4	3	2				A current set the ship 18 miles S. by W.
5	6	4				by compass
6	7	7				
7	2	3				
8	4	5	S.S.E.	S.W.b.W.	1¾	
9	2	6				
10	6	2				
11	4	3				
12	5	4				Variation ¾ pts E.

H.	K.	$\frac{1}{10}$	Courses.	Winds.	Lee Way	Remarks.
1						P.M.
2	6	0	S.W.	N. by W	0	I take my departure from a point of land
3	5	4				in lat. 4° 24′ N. long, 7° 46′W. bear-
4	6	4		N.W.b,N.		ing N.¼E. (by compass) dist. 18 miles.
5	7	2				
6	7	0	W. by S.		½	
7	6	6				
8	6	4				
9	7	0				
10	8	0				
11	7	6	N.W. by W.	S.W.b.W.	1	
12	7	4				A.M.
1	6	6				
2	6	4				
3	6	2				
4	5	6				A current set the ship E. by S.¼S. (by
5	5	2				compass) 15 miles in the 24 hours.
6	4	0	S. by E.		½	
7	4	6				
8	4	4				
9	5	0				
10	6	0	West.	S.S.W.	¼	
11	6	4				
12	6	6				Variation 1¾ pts. W,

H.	K.	$\frac{1}{10}$	Courses	Winds,	Lee Way	Remarks.
1						P.M. I take my departure from a point
2						of land, in lat. 34° 26′S. long. 172°
3						38′ E. bearing by compass E. b.S.¼S.
4						distant 17 miles.
5	4	2	S.S.W.	N.W.	¼	
6	3	4				
7	4	0				
8	6	4				
9	2	6	N.W.bW.	S.E.	0	
10	6	4				
11	6	0				
12	5	8	S.bW. ¾ W.	S.E.¼E.	2¼	
1	6	0				A.M.
2	6	4				
3	4	8				
4	2	4	N.N.E.	N.W.	2	
5	5	5				A current set the ship the last 4 hours, 2½
6	6	6				miles an hour by compass N.W.¼W.
7	6	5				
8	4	3	N.E.	W.	¼	
9	7	4				
10	6	2				
11	4	4				
12	5	7				Variation 1½ pts. E.

DAY'S WORKS.

H.	K	F.	Courses.	Winds.	Lee way.	Remarks,
1	3	0	West.	S.S.W.	1	I take my departure from a point in lat.
2	3	0				25° 39′ S. long. 45° 7′ E. bearing
3	3	0				N.W. by N. distant 9 miles.
4	4	0	S.S.E.	S.W.	¼	
5	4	5				
6	4	5				
7	5	0	S.b.E.	S.W.b.W.	0	
8	5	5				
9	5	5				
10	6	0				
11	6	0		.		A current setting to S.W. at the rate of 16
12	6	5				miles in the 24 hours.
1	7	0	S. by W.	W. by S	0	
2	7	0				
3	8	0				
4	8	0				
5	8	0	North.		½	
6	8	0				
7	8	0				
8	8	0				
9	7	5				
10	7	5				
11	6	0				
12	6	5				Variation 24° W.

H.	K.	F.	Courses.	Winds.	Lee way.	Remarks.
1						I take my departure from a point in lat.
2	6	0	W.b.N.	N.	0	34° 30′ S. long. 172° 49′ E. bearing E.
3	6	4				distant 17 miles.
4	6	6				
5	7	0				
6	8	0			¾	
7	7	6	S. W. ½ W.	N.W.b.W.	½	
8	7	4				
9	8	0				
10	8	6			¾	
11	8	4				
12	8	0	S. S. W.	W.	0	
1	7	6				
2	7	4				
3	8	0	W. S. W.	S. by E.	0	
4	8	0				A current sets to N. at the rate of 10 miles
5	7	6				in 24 hours.
6	7	4				
7	6	0				
8	6	6			¾	
9	6	4				
10	5	6				
11	5	4				
12	5	0				Variation 15° E.

Paper I.

1. Express in figures, ten millions ten thousand and ten.

2. Add together 17984, 739, 9, 6754, 896, 97, and 7493.

3. In 97864 cables, each containing 120 fathoms, how many inches ?

4. Divide 874687718592 by 9648.

5. March 20, 1854: long. 168° 45′W.; the observed meridian altitude ☉ 62° 10′ 40″; sun S. of observer; index error —1′ 50″; eye 18 feet; required the latitude.

6. Jan. 6, 1854, P.M. at ship; lat. by account, 61° 45′S.; long. 138° 8′E.; the observed altitude ☉ near the meridian, 50° 4′ 40″; observer S. of the sun; eye 19 feet; time by watch, 5ᵈ 23ʰ 59ᵐ 50ˢ which had been found 38ᵐ 46ˢ slow on apparent time at ship, but the ship had made 16′ diff. long. to W. since the error for apparent time had been ascertained; required the true latitude.

7. Jan. 6, 1854, P.M. at ship; lat. 4° 30′N; the observed altitude ☉ 30° 10′ 45″; index error —1′ 9″; eye, 21 feet; time by chronometer, 5ᵈ 18ʰ 59ᵐ 59ˢ, which had been found 7ᵐ 52ˢ fast on mean time at Greenwich, Oct. 17, 1853, and losing 4ˢ daily; determine the longitude.

8. Jan. 6, 1854, at 6ʰ 25ᵐ 32ˢ A. M. apparent time at ship; lat. 15° 30′N; long. 107° 37′W; the sun's rising amplitude was observed by compass to be E. 18° 20′S.; required the variation.

9. Jan. 6, 1854, at 3ʰ 40ᵐ 16ˢ P. M. mean time at ship; lat. 52° 45′S.; long. 66° 56′W.; the observed altitude ☉ 38° 31′ 40″; eye, 20 feet; sun's bearing by azimuth compass, S. 82° 50′W.; required the variation.

10. Jan. 6, 1854.—required the A.M. and P.M. tide at Shields.

11. Compute the course and distance by Mercator's sailing, from Cape Voltas, lat. 28° 44′S., long. 16° 32′E.; to Charleston, lat. 32° 41′N. long. 79° 53′W.

12. Correct the following courses for the local attraction as given at page 17,
    N. E.—E. by S.—S.S.W.—N. by W.—E.N.E.

Paper II.

1. Express in figures, nine hundred and nine thousand and forty.

2. Add together 8, 746, 84, 97631, 471, 140011, and 639.

3. In 8694 tons, how many ounces?

4. Divide 5240037752890 by 86321.

5. March 20, 1854.—long. 155°W.; the observed meridian altitude ☉ 50° 10′ 40″; sun N. of observer; index error —1′ 19″; eye, 18 feet; determine the latitude.

6. March 5, 1854, A.M. at ship; lat. by account 33° 40′N.; long. 20° 1′W.; observed altitude ☉ near the meridian 49° 50′; observer N. of sun; eye 22 feet; time by watch 5ᵈ 1ʰ 0ᵐ 30ˢ; the watch had been found 1ʰ 21ᵐ 14ˢ fast on apparent time at ship, but the ship had made 10′ diff. of long. to E. since the error for apparent time had been determined; required the true latitude.

7. March 28, 1854, P. M. at ship; lat. 20° 9′S.; observed altitude ☉ 30° 10′ 20″; eye, 26 feet; time by chronometer, 28ᵈ 0ʰ 4ᵐ 50ˢ, which had been found 46ᵐ 46ˢ fast on mean time at Greenwich, Nov. 29, 1853, and losing 4ˢ daily; required the longitude.

8. March 31, 1854, at 6ʰ 2ᵐ P.M. apparent time at ship; lat. 6° 25′N.; long. 156°E.; the sun's setting amplitude was observed by compass W. 3° 40′S.; determine the variation.

9. March 26, 1854. at 9ʰ 0ᵐ A.M. mean time at ship; lat. 43° 10′N.; long. 52° 30′W.; the observed altitude ☉ 32° 36′ 45″ bearing by azimuth compass S. 40° 30′E.; eye, 18 feet; required the variation.

10. Compute by Mercator's sailing, the course and distance from Point de Galle, lat. 6° 1′N., long. 80° 14′E.; to Zanzibar S. Point, lat. 6° 10′S. long. 39° 15′E.

11. Required the A.M. and P.M. tide at the Nore Light, on March 6, 1854.

12. Correct the following courses for local attraction, as given at page 17,

       East.—E.S.E.—N.N.W.—W.S.W.

Paper III.

1. Express in figures, one hundred and four millions ninety thousand and nine.

2. Add together 768, 4597, 8, 460, 62, 179634 and 98.

3. In 68049 statute miles, how many barleycorns?

4. Divide 6903523318679 by 84097.

5. April 6th, 1854 : long. 78° 45′E : the observed meridian altitude ☉ 47° 50′ 15″: observer S. of the sun : index error —1′ 20″, eye 19 feet : required the latitude.

6. April 21st, 1854, A.M. at ship : lat. by account 39° 53′ N. long. 6° 5′E : the observed altitude ☉ near the meridian 61° 27′ 35″: sun S· of observer : eye 18 feet : time by watch 21^d 0^h 1^m 50^s, which was found 20^m 50^s fast on apparent time at ship, but the ship had made 5′ diff. long. to E. since the error for apparent time had been determined : required the true latitude.

7. April 15th, 1854, A.M. at ship : lat. 41° 1′N.: observed altitude ☉ 35° 40′: eye 20 feet : time by chronometer 15^d 6^h 0^m 40^s, which had been found 2^m 1·4^s fast on mean time at Greenwich, Jan. 25th, and losing 5·5^s daily : required the longitude.

8. April 29th, 1854, at 5^h 32^m A.M., apparent time at ship : lat. 25° 11′N : long 136°W : the sun's rising amplitude was observed to be E. 24° 15′N : required the variation.

9. April 25th, 1854, at 2^h 42^m 10^s P.M. mean time at ship : lat. 48° 42′S. : long. 50° 40′E.: the observed altitude ☉ 18° 21′ bearing by compass N.7° 10′W.: eye 19 feet : required the variation.

10. April 4th, 1854 : required the A.M. and P.M. tide at Torbay.

11. Compute by Mercator's sailing, the course and distance from Angra Pequena, lat. 26° 38′S.; long. 15° 8′E.: to Cape St. Roque, lat. 5° 28′S.; long. 35° 17′W.

12. Correct the following courses for local attraction as given at page 17,

S.W.—N.W.—W.N.W.—South.

Paper IV.

1. Express in figures ninety millions two hundred and four thousand and fifty.

2. Add together 874, 97643, 96, 4, 371, 930872, and 15.

3. In 8076 centuries how may seconds? $365\frac{1}{4}$ days being reckoned to the year.

4. Divide 7941037222000 by 9839.

5. Sept. 23, 1854.—long. 166° 30′ E.; the observed meridian altitude ☉ 41° 30′; sun N. of observer; index error +1′ 19″; eye 17 feet; required the latitude.

6. July 10, 1854, A.M. at ship; lat. by account 51° 43′ N. long. 30° 10′ W.; observed altitude ☉ near the meridian 59° 47′; observer N. of the sun; index error —1′ 13″; eye 18 feet: time by watch $10^d 2^h 10^m$, which had been found $2^h 40^m$ fast on apparent time at ship, but the ship had made 10′ diff. long. to W. since the error for apparent time had been ascertained; required the true latitude.

7. July 29, 1854, A.M. at ship; lat. 40° 10′ S.; the observed altitude ☉ 17° 10′ 40″; eye 24 feet; time by chronometer $28^d 22^h 10^m 40^s$, which was $9^m 45\cdot5^s$ fast on mean time at Greenwich, June 8, and losing 6^s daily; required the longitude.

8. July 28, 1854, at $7^h 27^m 30^s$ A.M. apparent time at ship; lat. 47° 8′ S.; long. 84° 15′ W.; the sun's rising amplitude was observed by compass E. 42° 40′ N required the variation.

9. July 31, 1854, at $8^h 46^m 30^s$ A.M. mean time at ship; lat. 38° 18′ N.; long 65° W.; the observed altitude ☉ 43° 26′ 10″ bearing S 78° 20′ E; index error —1′ 12″; eye 19 feet; required the variation.

10. Required the course and distance by Mercator's sailing, from Port Jackson, lat. 33° 51′ S., long. 151° 18′ E.: to Acapulco, lat. 16° 51′ N.; long. 99° 52′ W.

11. Required the A.M. and P.M. tide, July 21st, at Whitby.

12. Correct the following courses for local attraction, as given at page 17,

West.—N.E. by E.—S.W. by W.—E.N.E.

Paper V.

1. Express in figures one hundred million sixty thousand four hundred and nine.

2. Add together 876, 4973, 64, 9, 754319 and 474.

3. In 769846 statute miles, how many inches ?

4. Divide 55175168630000000 by 8609000.

5. Sept. 23rd 1854 : long. 90° 45′ E.: the observed meridian altitude ☉ 83° 40′ 30″ : observer N. of the sun : eye 18 feet : required the latitude.

6 Sept. 16th 1854, A.M. at ship : lat. by account 42° 36′S.: long. 137° 10′E. : the observed altitude ☉ near the meridian 44° 10′ 30″ : sun N: of observer : index error —2′ 20″ : eye 19 feet : time by watch 16ᵈ 0ʰ 2ᵐ 46ˢ, which had been determined 23ᵐ 10ˢ fast on apparent time at ship, but the ship had made 14′ diff. long. to W. since the error for apparent time had been ascertained : required the true latitude.

7. Sept. 1st 1854, P.M. at ship : lat. 2ᵇ 10′N.: the observed altitude ☉ 28° 40′ : index error —47″ : eye 22 feet : time by chronometer August 31ᵈ 23ʰ 58ᵐ 49ˢ, which had been found 15ᵐ 26ˢ slow on mean time at Greenwich, June 23rd and losing 4·5ˢ daily : required the longitude.

8. Oct. 1st 1854, at 6ʰ 13ᵐ A.M. apparent time at ship : latitude 47° 10′N.: long. 15° 30′W.: the sun's amplitude at rising was observed E. 31°S.: required the variation.

9. Sept. 2, 1854, at 3ʰ P.M. mean time at ship ; lat. 39° 30′S. ; long. 37° 30′E. ; the observed altitude ☉ 26° 40′ 35″ ; eye 18 feet ; sun's bearing by azimuth compass N. 21° 10′W. ; required the variation.

10. Sept. 16, 1854.—required the A.M. and P.M. tide at Brest Harbour.

11. Required the course and distance by Mercator's sailing from Cape Hatteras, lat. 35° 14′N. ; long. 75° 30′W. ; to Cape Frio, lat. 18° 23′S. ; long. 12° 2′E.

12. Correct the following courses for local attraction, as given at page 17,

W. by S.—S. by W.—E. by S. ½ S.—N. W ½ W.

Paper VI.

1. Express in figures nine hundred millions two thousand and one.

2. Add together 8764, 987641, 470, 91, 9, and 8746.

3. In 6785 great circles how many seconds ?

4. Divide 120140420490 by 60070.

5. Sept. 23, 1854, long. 80° 15'E.; the observed meridian altitude ☉ 57° 20' 30"; observer S. of the sun; index error +1' 20"; eye 21 feet; required the latitude.

6. Dec. 16, 1854, A.M. at ship; lat. by account 33° 48'N.; long. 25° 19' E.; the observed altitude ☉ near the meridian, 32° 30' 40"S.; index error, +22"; eye 17 feet; time by watch, 16ᵈ 0ʰ 2ᵐ 54ˢ which had been found 22ᵐ 22ˢ fast, on apparent time at ship; but the ship had made 11' diff. of long. to the E. since the error for apparent time had been determined; required the true latitude.

7. Dec. 15, 1854, A.M. at ship; lat. 30° 49'N.; the observed altitude ☉ 17° 49' 0": index error, +34"; eye, 18 feet; time by chronometer, 15ᵈ 5ʰ 40ᵐ 44ˢ, which had been found 46ᵐ 10ˢ slow on mean time, at Greenwich, July 13, and was gaining 4·6ˢ daily; determine the longitude.

8. Dec. 16, 1854, at 7ʰ 24ᵐ 28ˢ P.M., apparent time at ship; lat. 40° 4'S.; long. 126° 7'E.; the sun's setting amplitude was observed to be W.27°30' 30"S.; required the variation of the compass.

9. Dec. 16, 1854, at 8ʰ 2ᵐ A.M. mean time at ship; latitude, 48° 58'S.; long. 149° 30'W.; the observed altitude ☉ 37° 4' 30", bearing by azimuth compass N.74° 0'E.; index error, 0; eye, 17 feet; determine the variation of the compass.

10. Dec. 16, 1854.—Required the A.M. and P.M. tide at Shields.

11. Determine by Mercator's sailing, the course and distance from Halifax, lat. 44° 39'N.; long. 63° 37'W.: to Cape Town, lat. 33° 56'S.; long. 18° 28'E.

12. Correct the following courses for local attraction, as given at page 17.

E. ½ S.—N.E. ½ E.—N. by E. ½ E.—N.N.W.

LOCAL ATTRACTION.

DEVIATION OF THE COMPASS.

Local Attraction is a term used to denote the influence of iron in disturbing the direction of the magnetic needle, whereby, according to the mass and position of that metal in respect to the compass, a greater or less amount of *deviation from the magnetic meridian* is the result. This derangement of the compass, some 30 years ago scarcely noticed, must have been the source of numberless accidents to vessels, often accompanied by a great sacrifice of human life ; for since that period, the careful researches of scientific observers, have proved that it would be extremely hazardous to allow the ships of H. M. navy, steamers, or iron-built vessels, to proceed to sea, without the amount of errors, arising from the local attraction being previously determined ; it may suffice to mention, in illustration, that in the screw steamer, "Shang-hai," the deviation with the ship's head South, amounted in the binnacle to more than fifteen points.

It must not be supposed that the compasses on board merchant vessels, are wholly free from the effect of local attraction : under ordinary circumstances, with no undue proportion of iron in the ship, the deviation may not be so great, as to produce any serious error on the courses made ; but the case is materially altered when the cargo consists in part, or wholly, of iron ; or in fact, when any single mass of that metal is placed in the vicinity of the binnacle.

The amount of deviation on a given point of the compass, is by no means a constant quantity, but it differs in different

vessels, each having a local attraction peculiarly its own ; it may also vary with change of position on the globe, as well as from circumstances connected with the vessel itself, or the needle,—or even both. It is therefore necessary that masters should be able to ascertain, as well as know how to apply, the errors arising from the magnetic disturbance : for this purpose two methods may be adopted,—the first being the most approved.

Method 1.—*With two compasses.*—The ship must be placed in such a position that she may be gradually swung, and the two compasses being compared together to note their agreement, let one of them be placed in the binnacle in its usual position, and the other taken on shore, beyond the influence of the attractive force; adopt such means that a good bearing of each may be taken, and as the ship's head is brought to each point in succession, of the compass on board, at that instant let observations be made, thus, the person on shore must take the bearing of the compass in the binnacle, and the person on board must take the bearing of the compass on shore, proceeding in this manner through the 32 points ; these bearings must be tabulated after the following method :—

Direction of Ship's Head.	Bearing of Shore Compass, from Compass on Board.	Bearing of Compass on Board, from Shore Compass.	Difference of bearings, or Deviation.

The difference between the bearings will be the amount of deviation due to the local attraction of the ship, and is named *East,* when the north point of the needle is drawn to the eastward or right hand,—*West,* when it is drawn to the westward or left hand ; and must be applied to the ship's courses in the same manner as the variation of the compass.

Method 2.—*With one compass.*—Having determined the

true bearing of a conveniently distant object, let the ship be carefully swung to each point of the compass, and on each occasion let the bearing of the object be taken ; the difference between the true and observed bearing will be the error of the compass, to be named and applied as in the former case.

The annexed table is the deviation of H.M.S. Vesuvius, from which the courses given in this work are to be corrected.

Direction of Ship's Head.	Deviation of Compass.	Direction of Ship's Head.	Deviation of Compass.
N.	2° 45′ E.	S.	3 0 W.
N. by E.	4 57	S. by W.	4 20
N.N.E.	7 30	S.S.W.	5 0
N.E. by N.	9 0	S.W. by S.	6 7
N.E.	10 0	S.W.	7 0
N.E. by E.	10 55	S.W. by W.	7 27
E N.E.	10 40	W.S.W.	7 50
E. by N.	9 55	W. by S.	8 20
E.	8 50	W.	8 50
E. by S.	7 15	W. by N.	8 10
E.S.E.	5 35	W.N.W.	6 50
S.E. by E.	3 40	N.W. by W.	5 40
S.E.	1 50	N.W.	4 50
S.E. by S.	0 20 E.	N.W. by N.	3 20
S.S,E.	0 56 W.	N.N.W.	1 40 W.
S. by E.	2 20	N. by W.	1 10 E.

THE ADJUSTMENTS OF THE SEXTANT.

1.—*The Index Glass should be perpendicular to the plane of the Instrument.* To determine if it be so, bring the vernier to the middle of the arc, and with the limb turned from the observer, look obliquely into the mirror, then if the reflected and true arcs appear as one continued arc of a circle, the index glass is in perfect adjustment.

2.—*The Horizon Glass should be parallel with the Index Glass, when 0 on the vernier exactly coincides with 0 on the arc.* To ascertain this, hold the instrument vertically, and direct the sight through the telescope or sight vane, to the horizon, and if the reflected and true horizons form one continuous line, the horizon glass is parallel with the index glass.

3.—*The Horizon Glass should be perpendicular to the plane of the Instrument.* With 0 on the vernier coinciding with 0 on the arc, hold the sextant horizontally, and looking at the horizon, observe if the reflected and true horizons are in one line: or, the instrument being held perpendicularly, look at any convenient object, as the sun, sweep the index glass, along the limb, and if the reflected image pass exactly over the direct image, without any lateral projection, the horizon glass is perpendicular.

4.—*To adjust the Line of Collimation,* or to set the axis of the telescope parallel to the plane of the sextant. Fix the telescope in its place, taking care that two wires are parallel to the plane of the instrument; select two objects, as the sun and moon, or moon and star, which are more than 90° distant from each other, bring them into contact on the wire nearest to the instrument; then by slightly moving the sextant, see how they appear on the other wire; if they are still in contact, the *Line of Collimation is in adjustment*; but if the bodies

separate when brought to the far wire, the object end of the
telescope *inclines towards* the plane of the sextant ; if they
overlap, it *declines from* the plane.

5.—*To determine the Index Error*, measure the sun's dia-
meter on the arc of the instrument, and on the arc of excess,
which is done by holding the sextant perpendicularly, and
bringing the true and reflected suns in exact contact on each
side of O ; *half the difference of the two readings* will be
the index error, which is additive when the reading on the arc
of excess is the greater, but subtractive when the reading on
the arc of excess is the less of the two.

THE LOG-LINE

The speed of a vessel is ascertained by means of the Log-
line, and a sand glass running a given number of seconds.
To determine the length of a knot on the log-line, we have
the following rule : The length of the knot (in feet) must bear
the same proportion to a geographical mile (in feet), that the
seconds of the glass, used at the time of heaving the log, bear
to the seconds contained in an hour; from which it follows,
that the number of knots, and parts of a knot run during the
interval indicated by the glass, will give the number of miles,
and parts of a mile the ship has sailed in an hour, supposing
the rate of sailing to be uniform.

The geographical mile being about 6080 feet, we have for
glasses running 28ˢ and 30ˢ respectively, the following pro-
portions :

$3600^s : 28^s :: 6080$ ft. $: 47 \cdot 288$ ft. $= 47$ ft. $3\frac{1}{2}$ in.

$3600^s : 30^s :: 6080$ ft. $: 50 \cdot 666$ ft. $= 50$ ft. 8 in.

the required lengths of the knot, but if 80 feet be rejected
from the geographical mile, and the first and third terms of

proportion reduced, by dividing them by 600, the statements become

$$6^{s} : 28^{s} :: 10 \text{ ft.} : 46\cdot66 \text{ ft.} = 46 \text{ ft. } 8 \text{ in. nearly}$$
$$6 : 30 :: 10 \text{ ft.} : 50 \text{ ft.}$$

hence the method very commonly adopted to ascertain the length of the knot: viz. annex a cipher to the number of seconds run by the glass, and divide this by 6.

The log-line must always have a sufficient quantity of what is termed "stray line," in excess of the admeasured portion, in order to allow the log to get clear of the eddy of the ship's wake; this must be determined by the size of the vessel.

It is recommended to divide the knot to tenths.

THE LEAD LINE.

In nautical phrase, the Lead Line has " nine marks and eleven deeps :"—

At 2 fathoms the mark is Leather,
    3 . . . . Leather,
    5 . . . . White Rag,
    7 . . . . Red Rag,
    10 . . . . Leather with a round hole in it
    13 . . . . Blue Rag,
    15 . : . . . . White Rag,
    17 . . . . Red Rag
    20 . . . . A piece of cord with two knots.

The Deep Sea Lead Line is marked in a similar manner to the 20 fathoms, after which a piece of cord with an additional knot for every 10 fathoms is fixed in the line, and between the tens, a piece of leather to denote five fathoms.

STEAMER'S LIGHTS.

The Act of Parliament passed in the 10th year of the reign of Her present Majesty, entitled an "Act for the Regulation of Steam Navigation," requires that *all British Steam Vessels* (whether propelled by paddles or screws) shall, *between sunset and sunrise,* exhibit the following lights :—

When under Steam, or Sail.

A Bright White Light at the Foremast-Head.

A Green Light on the Starboard Side.

A Red Light on the Port Side.

The Mast-Head Light is visible at a distance of at least five miles, in a dark night, with a clear atmosphere, and the *Lantern* is so constructed as to show a uniform and unbroken light, over an arc of the horizon of 20 points of the compass, being 10 points on each side of the ship, i. e. from right ahead to 2 points abaft the beam on either side.

Each Side Light is visible at the distance of at least 2 miles, in a dark night, with a clear atmosphere; the lantern of each is so constructed as to show a uniform and unbroken light, over an arc of the horizon of 10 points of the compass, but being fitted with an inboard screw, of at least three feet long, the light cannot be seen across the bows ; hence it follows, that the Green Light may be seen from right ahead to 2 points abaft the beam on the starboard side ; and the Red Light from right a head to 2 points abaft the beam on the port side.

When at Anchor, a common Bright Light is to be exhibited, the lantern of which is constructed to show a good light all round the horizon.

Sailing Vessels should also show a *bright light* at the mast head, when at anchor.

THE RULE OF THE ROAD.

1. Sailing Vessels having the wind fair, give way to those on a wind.

2. Vessels close hauled on the starboard tack, always keep their wind.

3. Vessels close hauled on the port tack, must give way to those on the starboard tack.

N.B.—Steamers are considered as vessels with a fair wind.

LIST OF THE LEADING LIGHTS OF THE ENGLISH CHANNEL.

On the English Coast.

The Light is bright unless otherwise specified.

Name of Light.	Number of Lights.	Fixed or Revolving	Interval of Revolution or Flash.	Miles seen in clear Weather.	Remarks.
Scilly	1	R.	Every minute.	16	
Seven Stones, Light Vessel	2	F.	. .	10	A gong is sounded during foggy weather.
Longships	1	F.	. .	14	
Lizard	2	F.	. .	20	
Eddystone	1	F.	. .	13	
Start	1	R.	Brilliant flash every minute.	19	A fixed light is also shewn in the direction of Berry Head.
Portland	2	F.	. .	{ 19 16	
Needles	1	F.	. .	27	Red sea-ward ; bright towards Hurst Point.

Name of Light.	Number of Lights.	Fixed or Revolving	Interval of Revolution or Flash.	Miles seen in clear Weather	Remarks.
St. Catherine....	1	F.	. .	18	
Bembridge, or Nab, Light Vessel	2	F.	. .	{ 8 / 10	A gong is sounded during foggy weather.
Owers, Light Vessel	1	F.	. .	10	A gong is sounded during foggy weather. When a vessel is standing into danger, a gun is fired.
Beachy Head....	1	R.	Two minutes; duration of flash 15 seconds.	22	
Dungeness......	1	F.	. .	14	
South Foreland..	2	F.	. .	{ 22 / 25	These lights in one, clear the south end of the Goodwin Sands.
South Sand Head, Light Vessel	1	F.	. .	10	A gong is sounded during foggy weather.
Gull Stream, Light Vessel	2	F.	. .	7	A gong is sounded during foggy weather.
Goodwin, or North Sand Head, Light Vessel	3	F. triangular.	. .	10	A gong is sounded during foggy weather.
North Foreland..	1	F.	. .	18	

On the French Coast.

Dunkerque......	1	R.	Every minute.	24	
Gravelines.......	1	F.	. .	15	
Calais..........	1	F.	Varied by a flash every four minutes.	21	

LEADING LIGHTS OF THE BRISTOL CHANNEL.

Name of Light.	Number of Lights.	Fixed or Revolving	Interval of Revolution or Flash.	Miles seen in clear Weather	Remarks.
Lundy	2	Upper R. Lower F.	Every two minutes.	30	
Flatholm	1	F.	. .	17	
Usk	1	F.	. .	1Q	
Nash	2	F.	. .	18 16	When in one, leading a cables length S. of Nash Sand.
Mumbles	1	F.	. .	15	
Helwick, Light Vessel	1	R.	Every minute.	10	A gong is sounded in foggy weather.
Caldy..........	1	F.	. .	19	Part bright, part red.*
St. Ann's.......	2	F.	. .	19 17	When in one, they lead clear of the Crow and Toes Rocks

* The E. limit of the Red light, clears the W. end of the Helwicks, bearing S.E. by S. distance 13 miles.

Addenda to the Lights of the English Channel.

Lizard: When in one, the Lizard Lights lead clear of the Manacles to the E.; and of the Wolf to the W.

Portland: When in one, the Portland Lights lead between the Race and Shambles.

Paper I.

March 20th, 1854: at 7^h 17^m P.M. mean time at ship: longitude 19° 56′W.: the observed altitude of Polaris, 54° 50′ 40″: index error +1′ 10″: eye, 23 feet: required the latitude.

Feb. 17th, 1854: A.M. at ship: approximate latitude, 39°: long. 166° 30′E. : observed meridian altitude ☾ 50° 10′ 40″: ☾ S. of observer: index error, +1′ 2″ : eye, 18 feet : required the true latitude.

April 2nd, 1854 : the following double altitude of the Sun was taken:—

apparent time at ship,   obs.alt. ☉

$1^d 20^h 16^m 44^s$ . . . . . 31°24′ 13″ bearing N.E. by E. ¼ E.

1 23 49 48 . . . . . 64 23 45

the course and distance made in the interval being S.E. 28 miles: eye, 22 feet: required the true latitude when the second observation was made, the position by account being at the time, lat. 30° 2′N.: long. 171° 11′E.

Jan. 7th, 1854 : P.M. at ship : lat. 40° 36′S. : the following lunar observation was taken:—

obs. alt. ☉   obs. alt. ☾   obs. dist. near limb,

35° 29′ 50″   24° 24′ 50″   108° 5′ 40″

index err.   —18   —8   +14

eye, 27 feet: time by chronometer, 7^d 6^h 20^m 2^s, which was estimated to be 20^m 2^s fast on mean time at Greenwich: required the error of the chronometer on mean time at Greenwich, by lunar observation : also the ship's longitude.

A ship, by dead reckoning has made S.44°E. 97 miles, but by observation she is found to have made S.11 W. 101 miles: determine the set and drift of the current.

Paper II.

July 10th, 1854: at 11ʰ 54ᵐ 40ˢ P.M. mean time at ship: long. 171° 50′E: the observed altitude of Polaris, 61° 0 30″: index error, —1′ 39″: eye, 27 feet: required the latitude.

Nov. 27th, 1854: approximate latitude, 34°: long. 48° 15′W: observed meridian altitude ☽ 45° 10′ 40″: observer N. of ☾: eye, 17 feet: required the true latitude.

Dec. 12th, 1854, the following double altitude of the sun. was taken :—

apparent time at ship.	obs. alt. ☉
12ᵈ 0ʰ 20ᵐ 12ˢ	59° 24′ 9′ bearing N. 21°E.
12 4 0 12	35 57 26

the course and distance in the interval, N. 33°W. 28 miles : eye, 19 feet: required the true latitude when the second observation was made, the ship's position at the time being by account, lat. 52° 58′S.: long 60° 3′E.

Feb. 6th, 1854: at 5ʰ 20ᵐ 46ˢ P.M. by watch at ship: lat. 50° 13′N. long. by account, 22°W.:

obs. alt. Venus (centre)	obs. alt. ☽	obs. dist. ☾ n.l. and Venus' centre
24° 26′ 0″	51° 59′ 0″	80° 9′ 10″
ind. err. +32″	+41″	— 15″

eye, 25 feet: required the true longitude.

A ship by dead reckoning makes E. 158 miles, but by observation, N. 48° E. 130 miles : required the set and drift of the current.

Paper III.

May 15th, 1854, at 11ʰ 0ᵐ 50ˢ P.M. mean time at ship : long. 30° 40′W. : the observed altitude of Polaris, 49° 58′ 40″ : index error, —50″ : eye, 22 feet : required the latitude.

May 10th, 1854, approximate latitude, 55° : long. 86° 15′E. observed meridian altitude ☽ 40° 10′ 30″ : observer S. of ☾ : eye, 24 feet : required the true latitude.

May 9th, 1854, the following double altitude of the sun was taken :—

apparent time at ship,	observed altitude ☉,
8ᵈ 20ʰ 13ᵐ 40ˢ	35° 11′ 21″ bearing S.41°E.
9 0 23 40	59 49 8

the course and distance made in the interval S.70°W. 6 miles per hour : eye, 22 feet : required the true latitude when the second altitude was taken : the ship's position at the time being by account lat. 46° 59′N. : long. 46° 35′W.

May 9th, 1854, at 8ʰ 36ᵐ P.M. by watch at ship : lat.8° 26′S. : long. by account, 107° 42′W.

obs. alt. Pollux,	obs. alt. ☾,	obs. dist. near limb,
19° 30′	69° 15′ 20″	84° 17′ 20″
index error 0	—1 16	+9

eye, 17 feet : required the true longitude.

A ship by dead reckoning, makes N. by E. 106 miles, by observation she is found to have made N.N.W. 100 miles; determine the set and drift of the current.

Paper IV.

Jan. 18th, 1854, at 7ʰ 15ᵐ 35ˢ P.M. mean time at ship: long. 168° 40′E.: the observed altitude of Polaris. 45° 10′ 40″: eye, 21 feet: required the latitude.

Dec. 29th, 1854, approximate latitude, 13°: long. 90° 45′E.: the observed meridian altitude ☾ 60° 40′ 15″ : ☾ N. of observer: eye, 23 feet: required the true latitude.

June 15th, 1854, the following double altitude of the sun was observed :—

apparent time at ship,	obs. alt. ☉,
14ᵈ 20ʰ 1ᵐ 32ˢ	22° 10′ 44″ bearing N.42°E.
15 0 21 32	54 13 22

the course and distance, in the interval, being S.30°W. 6 miles per hour: eye, 27 feet: required the true latitude when the second observation was taken, the ship's position at the time being by account, lat. 11° 53′S. : long. 89° 37′W.

Feb. 19th, 1854, A.M. at ship: lat. 6° 4′S.: the following lunar observation was made :—

obs. alt. ☉	obs. alt. ☽	obs. dist. near limb.
41° 36′ 0″	26° 56′ 30″	108° 5′ 40″
index err. +14	0	—35

eye, 25 feet: time by chronometer, 18ᵈ 13ʰ 2ᵐ 50ˢ, which was supposed to be 17ᵐ 6ˢ slow on mean time at Greenwich : determine the error of the chronometer on mean time at Greenwich by lunar: also the longitude.

A ship by dead reckoning had made N.W. 76 miles, but by observation it is found she has made S. 81°W. 61 miles: required the set and drift of the current.

Paper V.

1. Jan. 14th 1854 : long. 20°W. : the observed meridian altitude of Sirius (*a* Canis Majoris) being 37° 50′ 20″ : observer N. of the star : index error + 1′ 4″ : eye 19 feet : required the latitude

2. July 1st 1854 : long. 87°E. : the observed meridian altitude of Antares (*a* Scorpii) being 68° 45′ 30″ : star N. of observer : eye 21 feet : required the latitude.

3. August 1st 1854 : long. 36° 15′W. : the observed meridian altitude of the planet Jupiter being 60° 30′ 40″ : planet S. of observer : index error + 1′ 11″ : eye 18 feet : find the latitude.

4. April 23rd, 1854 : at 8^h 32^m 40^s A.M. apparent time at ship : lat. 40° 10′N. : long. 34° 18′W. : determine the true and apparent altitudes of the sun and moon.

5. Oct. 2nd 1854 : at 8^h 26^m 54^s P.M. mean time at ship : lat. 36° 10′S. : long. by ac. 18°E. : the observed distance of Antares (*a* Scorpii) from the ☽'s near limb being 74°46′ : index error + 5″ required the true longitude.

6. Nov. 29th, 1854 : at 6^h 42^m 24^s P.M. mean time at ship : lat. 24° 58′N. : long. by ac. 134°W. : the observed distance of Jupiter's centre from ☾'s near limb being 79° 44′ 20″ : index error —16″ : required the true longitude.

7. April 15th 1854 : lat. 16° 50′N. : long. 99° 52′W. : equal altitudes of the sun's lower limb being observed, when the corresponding times by chronometer were 15^d 3^h 50^m 40^s and 15^d 9^h 20^m 40^s : determine the error of the chronometer for apparent and mean time at the place of observation.

8. Feb. 19th 1854 : the following double altitude of the sun was observed—

apparent time at ship,   obs. alt. ☉

    8^h 45^m 50^s a.m.   41° 30′ 45″ bearing S.76°E.

    0 58 50 p.m.   74 20 27

eye 24 feet : the course and distance in the interval being N.24°E. 31·6 miles : required the true latitude when the second observation was taken, the ship's position being by account lat. 6° 4′ S. : long. 115° 1′ E.

Paper VI.

1. July 21st 1854 : long. 18° 45′E. : the observed meridian alti-
tude of the planet Jupiter being 69° 40′ 10″ : observer S. of the
planet : eye 21 feet : required the latitude.

2. Dec. 3rd 1854 : long. 175°E. : the observed meridian altitude
of *a* Arietis being 46° 20′ : star N. of observer : eye 20 feet : re-
quired the latitude.

3. Dec. 16th, 1854 : long. 147°W. : the observed meridian
altitude of Aldebaran (*a* Tauri) being 50° 13′ 15″ : the zenith N. of
the star : index error —1′ 17″ : eye 18 feet : required the latitude.

4. Nov. 15th 1854 : A.M. at ship : lat. 39° 50′N. : the observed
altitude ☉ 22° 26′ 30″ : index error +12″ : the observed altitude
☾ 52° 14′ 20″ : index error 0 : the observed distance of ☉ and ☽'s
near limbs 59° 46′ 10″. index error 0 : eye 16 feet : time by chro-
nometer 15ᵈ 1ʰ 0ᵐ 58ˢ, which was supposed to be 48ᵐ 11·5ˢ slow
on mean time at Greenwich : required the error of the chronometer
on Greenwich mean time by lunar, and the longitude.

5. May 11th 1854 : at 9ʰ 48ᵐ 31ˢ P.M. mean time by watch at
ship : lat. 38° 40′S : long. by ac. 171° 6′E. : the observed distance
of Regulus (*a* Leonis) and ☾'s near limb being 65° 50′ 30″ : index
error +1′ 16″ : required the true longitude.

6. Dec. 9th 1854 : lat. 48° 52′N. : long. 144° 46′E. : equal
altitudes of the sun's lower limb being observed when the corre-
sponding times by chronometer were 8ᵈ 20ʰ 12ᵐ 42ˢ and 8ᵈ 22ʰ
30ᵐ 46ˢ : required the error of the chronometer for apparent and
mean time at the place of observation.

7. Oct. 4th 1854: lat. 34° 19′S.: long. 115° 6′E.: equal altitudes of the sun's lower limb being observed, when the corresponding times by chronometer were 3^d 19^h 0^m 50^s and 3^d 23^h 50^m 50^s: required the error of the chronometer for apparent and mean time at the place of observation.

8. June 15th 1854: the following double altitude of the sun was observed,—

apparent time at ship,	obs. alt. ☉
8 1 32 a.m.	31° 54′ 38″bearing N.E.b E.¼E.
0 21 32 p.m.	74 59 34

eye 20 feet: the course and distance in the interval being S.W. by W.¼W. 32½ miles: required the true latitude when the second observation was made; the ship's position by account being, latitude 9° 26′N.: long. 89° 37′W.

LAW OF STORMS.

BY W. R. BIRT.

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The object of the following remarks on Revolving Storms, is to exhibit the importance of gaining such a knowledge of the "Law of Storms," that the commander of a vessel may know instinctively what part of a Cyclone he may be in; for this, nothing more is requisite, than that he possess a competent knowledge of the bearing of the centre from the ship, as determined by the direction of the wind; and the result of the hauling of the wind with or against the sun, as indicating on which side of the axis line he may be placed, the axis line coinciding with the *path of the centre;* with this knowledge all instruments may be dispensed with, exept the barometer.

1. Within the last 30 years the assiduity of meteorologists has developed a most important and highly interesting department of meteorology. This department has immediate reference to, and must exert a most beneficial influence on the Commercial and Maritime interests of the Country. It is now popularly known as the Law of Storms, and on no class of men can the study of it tell with more effect than on the mercantile marine; not that Her Majesty's Navy stands less in need of the important knowledge contributed by an investigation of storms, but the education of its officers fits them more readily to appreciate and apply such knowledge when overtaken by a hurricane or cyclone.

2. The primary idea or fundamental notion of a cyclone, is that of a vast body of air in a state of rotation, more or less rapid. This rotation appears to be immediately connected with the rotation of the earth, or rather with the apparent course of the

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sun in the heavens, arising from the earth's rotation on its
axis. The rotation of the air around the axis of the cyclone
producing the hurricane wind, is *always* contrary to, or against
the apparent course of the sun, and as the apparent course of
the sun is reversed in the opposite hemispheres, so the rotation
of the air in the cyclone is in opposite directions on either side
of the equator. A very simple rule is deducible from these
beautiful facts. In the northern hemisphere the cyclone ro-
tates in a direction contrary to that in which the hands of a
clock move, but in the southern hemisphere the rotation coin-
cides with the movement of the hands.

3. This whirling of the air in a cyclone, enables us to
characterize certain portions of the storm by certain hurricane
winds; thus, in the northern hemisphere the *northern* margin
of the storm always exhibits an *easterly* wind, the *eastern*
margin a *southerly* wind, the *southern* margin a *westerly* wind,
and the *western* margin a *northerly* wind; we shall also fur-
ther find upon dividing the storm into quadrants by diameters
drawn from the northern to the southern, and from the
eastern to the western margins, that upon the *northern* semi-
diameter, or radius, the wind will be *east*; on the *eastern*,
south; on the *southern*, *west*; and on the *western*, *north*;
each portion of the cyclone will possess its appropriate wind.

4. The relation of the winds to the margins and semi-
diameters in the southern hemisphere, will be exactly the re-
verse of their relations in the northern; thus it is the *southern*
semi-diameter and margin of a storm, south of the equator,
that exhibits an *easterly* wind, the *western* a *southerly*, the
northern a *westerly*, and the *eastern* a *northerly*.

5. This arrangement of the winds in a hurricane will
conduct us to a very simple rule for determining the position
of a vessel in a cyclone, and as a consequence the bearing of
the centre of the storm from the ship. From an *easterly* wind

in the northern hemisphere, the centre will bear *south*, or *eight* points, *reckoned in the same direction as the apparent course of the sun*, an *easterly* wind characterizing the *northern* margin ; from a *northerly* wind the centre will bear *east* ; from a *westerly* wind it will bear *north* ; and from a *southerly* wind, *west* ; thus the direction of the wind *only* in a revolving storm, will announce to the commander of the vessel, two very important points, his exact position in the cyclone, and the bearing of its centre from his ship.

6. The same simple and very perspicuous rule holds good in the southern hemisphere. From an *easterly* wind, the centre of the storm bears *north*, or *eight* points, *reckoned in the same direction as the apparent course of the sun*, the sun rising in the east, culminating in the north, and setting in the west. From a *southerly* wind the centre bears *east* ; from a *westerly, south* ; and from a *northerly, west*. These bearings are precisely the *reverse* of those in the northern hemisphere, but as the apparent motion of the sun is also *reversed*, the rule is applicable to both hemispheres. THAT THE CENTRE OF A REVOLVING STORM BEARS *EIGHT* POINTS FROM THE DIRECTION OF THE WIND AT THE SHIP, RECKONED WITH THE APPARENT COURSE OF THE SUN.

7. While the atmosphere *within* the cyclone is in so rapid a state of rotation, that the moving air frequently attains a velocity of about one hundred miles an hour, the exterior zone is strikingly characterized by certain meteorological appearances, which herald, as it were, the approach of the coming storm. The rapid motion of the air within the whirl, combined with the *sucking in* of the exterior air comparatively at rest, produces an immense condensation of vapour generally seen on the horizon in the direction of the cyclone, as a dense, dark, lofty wall or bank of cloud. As the vessel approaches the storm, this bank of cloud appears to advance,

and draw down closely upon the ship, so that she becomes
involved, and then the clouds present so appalling an aspect,
they appear to be so close to the vessel, and so solid in their
structure, that a commander may almost fancy he can from
the vessel, put his hand on them.

8. When the ship approaches so near the cyclone, as to
experience the effect of the outer gyration, the weather be-
comes still more significant, the proper wind of the hurricane
generally characterized as strong and squally, carries over the
vessel portions of the great bank of cloud peculiar to the stôrm,
these portions are torn into rags and shreds, while the bank
still marks the locality of the cyclone. From this point a run
of two hours *toward* the eentre will generally involve a ship in
an impetuous and terrific hurricane.

9. The feature next in importance to the rotation of a
cyclone, is its progressive motion, and this in all ordinary
cases is reducible to the same order and regularity as we have
seen characterizing the rotation; commencing at a point a few
degrees north of the line, the cyclone moves bodily forward
towards the west, its course is however soon directed a little
north of west, and as it approaches towards 20°N. lat. its course
is more or less towards N.W., at 30°N. lat. its course for a
short time is due north, here it *recurves*, and afterwards is
directed towards the N.E. This course is peculiar to the
western portion of the basin of the Northern Atlantic. The
usual storm paths in this locality, may be divided into ordinary
and extraordinary. The ordinary conforming to the course
above mentioned, and the extraordinary, departing from this
type.

10. Upon combining the rotatory with the progressive
motion, some very valuable rules for the guidance of com-
manders may be deduced. The path which the axis of gyra-
tion describes, is not inappropriately termed the *axis line*, and

this divides the cyclone into two *semi-circles*, the right or *star-board* semi-circle, and the left or *port* semi-circle; we have consequently three divisions of a storm, each characterized by different phenomena. In the right hand semi-circle, the hauling of the wind resulting from the passage of a cyclone, in the northern hemisphere, is in the same direction as the apparent course of the sun, but in the left hand semi-circle it is reversed, being opposite to or against the sun. On the axis line there is no change of wind until the centre has passed, when after a short lull or calm, the wind springs up with great fury from the opposite quarter.

11. The rules deduced from the progressive motion of a storm, combined with its rotation, are probably best enunciated as well as elucidated by a series of examples, of which the first has reference to the western portion of the basin of the Atlantic, where the ordinary storm paths follow more or less the course of the Gulf stream.

(a.) A vessel pursuing the usual course to the West Indies, shortly after passing 50°W. long. observes unmistakeable meteorological signs of a hurricane bearing down upon her, *i.e.* the dense bank of cloud, &c. is seen astern, not ahead; when she becomes involved in the scud, and the jagged and torn clouds skirting the cyclone, are flying swiftly past her, the steady N.E. trade is replaced, not by a wind from a different quarter, but by a wind still from the N.E. of greater intensity, and characterized by strong and sudden squalls; she is now upon the N.W. margin, or rather just within the N.W. verge, the centre bears S.E. of her, and if she scud before the wind, she will approach the axis line of the storm. If however, she should heave-to on the *star-board* tack, and allow the cylone to pass over her, the wind will haul by E.N.E. E. E.S.E. S.E. and S.S.E.

this will be in accordance with the apparent course of the sun, and an extensive generalization indicates that in the northern hemisphere the wind always HAULS WITH THE SUN IN THE RIGHT HAND, OR STARBOARD SEMICIRCLE OF A ROTARY STORM.

(b.)   A vessel pursuing the same course, when overtaken by a cyclone, and observing the significant meteorological signs, experiences a slight change of the N.E, trade; the wind changes to N.N.E. and rapidly increases in force, until at last, with a very furious wind from the same quarter, N.N.E., it becomes suddenly calm, after this calm has continued about half an hour or more, the wind as suddenly springs up from the opposite quarter, or S.S.W. while this wind continues, its force abates until the storm has passed, and the N.E. trade again resumes its sway.   In this instance, at the commencement of the storm, the centre of the cyclone bears E.S.E. of the ship, and afterwards passes over it, so that the general rule may be deduced, that ON THE AXIS LINE, A VESSEL EXPERIENCES ONLY *TWO* WINDS, ONE THE OPPOSITE OF THE OTHER, WITH AN INTERVENING CALM BETWEEN.

(c.)   A third vessel experiences a still greater change of wind; the N.E, trade instead of being replaced as in the first instance, by a *violent wind* from the same quarter, (the N.E,) is succeeded by a northerly wind.   If this vessel lie-to on the *starboard* tack, the winds she will experience will be as follows, N.W. W. and S.W. The hauling in this case is exactly in the opposite direction to that in the first instance, it is contrary to, or against the apparent course of the sun; THE HAULING OF THE WIND THEREFORE, IN THE LEFT HAND OR PORT SEMICIRCLE OF A REVOLVING STORM IN THE NORTHERN HEMISPHERE, WILL ALWAYS BE AGAINST THE SUN.

These rules will be found very valuable. The direction of the wind at the ship, will give her position in the storm as referred to the points of the compass, and what is of immense importance, the bearing of the centre from her; the hauling of the wind will announce her position relative to the axis line, and combined with her track through the cyclone, will give the direction in which the storm itself is moving ; if the wind be found to increase in force *without hauling*, the ship is on the axis line, and if a calm occur, succeeded by a terrific and violent wind from the *opposite quarter*, the ship has passed through the centre.

12. Most of the West Indian vessels, and those navigating portions of the Atlantic Ocean, off the Mexican Archipelago, will generally experience the winds of the starboard semi-circles of cyclones, in which they may happen to be involved. It will only be as a general principle when they are within the Caribbean Sea, the Gulf of Mexico, or the Channels between the Islands, that they will experience the winds of the port semi-circle. In the latter instances, there are no means of avoiding the fury of the storm by standing towards the margin, except it should sweep over the more open parts of the Caribbean Sea, and Gulf of Mexico. Vessels in the Atlantic may readily avoid the violence of the winds of the starboard semi-circle, by standing to the north and north-east, and by being so trimmed that they may receive the cyclone wind on the starboard side of the ship.

13. We are here introduced to a rule of very considerable importance, in manœuvring a vessel when overtaken by a storm of a revolving character. In the northern hemisphere, if a ship receive the wind on her *port* side, her head is directed more or less *towards* the centre of the cyclone; but if she receive it on her *starboard* side, her head is turned *away* from the centre. These facts readily indicate the means to be

adopted, either to retire to, or beyond the margin of the storm, or to draw from the centre when lying to. If with the ship's head from the centre, she receive the wind on the starboard side, then in lying to or drawing from the centre, she must be trimmed on the *starboard tack.**

14.   In the example (a) a West Indian vessel taking the storm at N.E. it is stated "that if she scud before the wind, she will approach the axis line of the cyclone," she will in fact be rapidly approaching *the centre,* which in consequence of its curved path, is likely under these circumstances, soon to over- take her.   In no other part of the storm does a vessel so rapidly near the centre by scudding, as in this, and *the octant of the starboard semi-circle in advance of the centre, and abutting on the axis line,* is consequently regarded as by far the *most dangerous* portion.   When the gale sweeps along the islands separating the Caribbean Sea and Gulf of Mexico, from the Atlantic, the most dangerous octant is characterized by north-easterly and easterly winds.

15.   Mr. Piddington in one of his admirable works on Indian Storms, has this pertinent remark on the utility of the barometer, "He who watches his barometer, watches his ship."   The barometer is an invaluable instrument in a cyclone, it announces to the commander his approach to the vicinity of a revolving storm, it advertises him of his plunging into its vortex, it acquaints him with his recess from the centre, and by carefully noticing its indications, he may to a great extent, avoid the disastrous consequences of a hurricane, the laws of its oscillations in a cyclone, are very distinctly marked.

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* The reverse of this takes place in the Southern Hemisphere, a vessel sailing *out of* the gale, receives the wind on her *port* side, she must there- fore be trimmed on the *port tack.*

16. A short time before the significant meteorological appearances noticed in sections 7 and 8 are observed, the atmosphere is generally, especially in certain latitudes, very calm, the air is oppressively sultry, and the barometer usually stands very high. Observations appear to indicate that this is mostly, if not always the case, *around* the storm, so that it is surrounded by a margin, characterised by a *high barometer*, and a hot, sultry atmosphere. In the direction of the cyclone, the clouds assume the appearance of a dark, livid bank, in most cases presenting an appalling and threatening aspect. If a diameter of the cyclone be drawn transverse to the axis line, dividing the starboard and port semi-circles into two equal quadrants, it will exhibit those portions of the storm, in which the barometer will fall and rise. While the first half of a storm passes a ship, the barometer will fall, and while the succeeding half passes it, the barometer will rise. The transverse diameter will also be characterized by a barometer which is proportionably lower, as the centre of the cyclone is approached. In most cases of manœuvring, it is desirable to keep just within the verge of the storm; and here, the barometer is of signal benefit, as, by keeping it as high as possible, without losing the cyclone winds, the vessel is kept just within the margin. In whatever position the ship may be, the rising of the mercury announces that the first half has passed.

17. Vessels navigating the Atlantic, off the Bahamas, and Florida, will experience important differences in the phænomena, according as they pass through the starboard, or port semi-circles of a cyclone. Sweeping along the West Indian Archipelago, the path of the cyclone has been, more or less, towards the north-west: a vessel with a north-westerly course, receives the northern margin of the gale with the wind from east, and if she pursue her course, the cyclone gaining on her, she soon experiences a favourable wind for her voyage, the

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barometer falls until she is fairly under the influence of the S.E. wind, and by sailing parallel with the centre, she has a fair wind for the rest of her voyage, *provided the cyclone does not alter its direction: the fresh breeze from the S.E. with a steady barometer, indicates that she preserves her parallelism with the centre.* If, however, the barometer fall, and bad weather be rapidly experienced, the course of the ship no longer continues parallel with that of the gale; the centre is rapidly nearing her, and if means were not adopted to keep the vessel near the margin, it would, under the circumstances here supposed, be so involved, that the centre would shortly overtake her. In the locality mentioned, a S.E. wind will invariably conduct the vessel to the centre, but if she lie-to as soon as she finds the barometer falling, she will avoid getting nearer the centre, the wind will continue to haul with the sun, and the gale will finally leave her between S.W. and W. The most advantageous manœuvre in these localities, would be to lie-to, as soon as unmistakeable indications of the cyclone *recurving* were perceived; " to wait on it," (to use the expressive phrase of an East Indian Captain,) until the passage of the S.E. wind, succeeded by a rising barometer, gave notice that the first half of the gale had passed, and then to cross the receding portion as far from the centre as may be consistent with safety, in order to pursue the original course of the vessel.

18. From the above remarks it is evident, that if a vessel navigating these seas, take the cyclone with any wind in the port semi-circle, the recurving will so operate, that the vessel will soon be removed from its influence, but a vessel in the starboard semi-circle, requires more than ordinary care in manœuvring, to avoid the centre bearing down upon her.

19: Vessels bound from England to America, as they approach the coasts of the United States, will usually experience the starboard winds of a cyclone : these winds will differ,

to some extent, from those characterizing the starboard semi-circle of the West Indian hurricanes, inasmuch, as the general direction of the storm path is, in the case before us, towards the N.E. Upon the track, south of the Gulf Stream, the vessel may take the hurricane by sailing into it at two points; she may either sail into the posterior quadrant, getting a westerly wind, which upon her waiting, will soon leave her; or the hurricane may meet her in the most dangerous octant, with the wind at south : in this case, upon her lying to, the wind hauling with the sun, she will experience the following winds,—S., S.S.W., S.W., W.S.W. and W.: as in this case, and also in those of the two northern passages, a vessel upon being involved, will have the hurricane interposed between it and the land, the most prudent step appears to be, "to wait on the cyclone," until the S.W. wind has passed, and the barometer begins to rise, when the earliest opportunity may be embraced for crossing its wake.

20. The entire storm paths of the Western Atlantic, are characterized by certain winds, that are *most dangerous* to vessels falling in with the, West Indian and North American cyclones. Off the West Indian Islands, the most dangerous cyclone winds are, N.E. and E.N.E. A short time before recurving, or rather about the period of recurving, vessels off the Bahamas and Florida, find E., E.S E. and S.E. winds most dangerous : after recurving, vessels off the coasts of the United States, are placed in considerable jeopardy by S.S.E. and S. winds. The general sweep of dangerous winds in the Northern Atlantic, may be thus specified :—

N.E., E.N.E., E:, E.S.E., S.E., S.S.E. and S.

21. The hurricane season generally sets in, in the Northern Atlantic, as the sun is leaving the tropic of Cancer, shortly after the summer solstice, and continues, until he has passed

to some distance south of the equator; the cyclone months are consequently, July, August, September and October.

21*.   The remaining localities in which storms are frequent, in the northern hemisphere, are the Bay of Bengal, and the China Seas.   In the Bay of Bengal, the progressive motion is towards the N.W. or, more properly speaking, from E.S.E. to W.N.W.   The same rules apply to these hurricanes, as to those of the Northern Atlantic, the hauling of the wind on each side of the axis line, being similar to the hauling, in a West Indian hurricane, *before recurving;* consequently, the winds affecting the ship, are the same.   In the China Seas, the progressive motion, hauling of the wind, &c., are almost identical with those in the Bay of Bengal, and in both localities, no recurving is observed.   The hurricanes in the bay, and the typhoons in the China Seas, appear to lose themselves in, or are dispersed by, the more elevated continental tracts, over which they pass, before they can reach the locality of recurving, in the northern hemisphere.

22.   We have already alluded to the fact, that the rotation of a cyclone in the southern hemisphere, is exactly opposite to the rotation of one in the northern, (sec. 2.), both being opposed to the apparent course of the sun.   The hurricane region, south of the equator, extends, more or less, over the entire area of the S.E. trades, in the Indian Ocean, the season in which they occur, being characterized, as in the northern hemisphere, by the sun leaving the tropic, and approaching the equator; this is from December to April, as the sun leaves the tropic of Capricorn.   Hurricanes are very seldom met with in November or May, and in the remaining five months of the year, so far as our present knowledge extends, they are unknown.

23.   The progressive course of the southern cyclones is in accordance with similar laws characterizing that of the northern; commencing a few degrees south of the equator, they move

first towards the west, very slightly inclined to south; as they approach 20° S. lat., the direction of their progress becomes S.W., and just before reaching 30°S. lat., they recurve, after which they move towards the S.E., and there is great reason to believe, that not very long after the point of recurving, their progressive motion is nearly due east.

24. There appears to be a very remarkable, and most interesting difference, in the latitudes of recurving in the southern hemisphere, as compared with the northern; while the latitude of 30°, may be regarded as the *mean* locality of recurving, so far as distance from the equator is concerned, the cyclones of the Indian Ocean are liable to recurve on any meridian, between the Cape and the western coast of Australia, and it would appear from observations, that they recurve in *lower* latitudes on the more *eastern* meridians. In this way, taking the apices of the cyclone paths more and more west, a curved line may be traced from about 60° E. long. to the Cape, on which the latitude of recurving varies from about 28° to 35° south. This line of recurving is of very considerable importance, when it is considered that the great highway of the ocean, from India and China to the Cape, is nearly identical with it, indeed, the two may be considered as pursuing the same track for about 20 degrees of longitude, viz. from 70° to 50° east, so that vessels coming from India and China, and sailing through this portion of the Indian Ocean, any time between December and April, are not only liable, on any day either to sail into a cyclone, or have one bearing down upon them, but their manœuvring may be proportionably complicated by the hurricane recurving, while they are within its influence.

25. The progressive motion of a southern cyclone combined with its rotation, will produce phenomena, as well marked as those which we have seen characterizing the northern

storms.   A vessel steering W.S.W., in the S.E. trades, ob-
serves all the significant meteorological signs of a hurricane
astern, and particularly to windward.   The wind alters its
character, instead of being a steady, fresh breeze, it becomes
gusty and squally, the atmosphere is obscured, patches of
cloud come away from the denser masses, of a loose, vapoury,
ragged and torn character.   These appearances, in such a lo·
cality are decisive, the ship is on the S.W. verge of a cyclone,
and most probably on the axis line.   In this instance, the
winds of the S.E. verge, are peculiarly favourable for the prose-
cution of the voyage, being north easterly.   Two points are
consequently matters for consideration, viz., to avoid the cen-
tre, and to get a favourable wind from the storm,—the liability
of the cyclone to recurve, must not however be lost sight of,
and the commander must keep a sharp and steady look out,
for the first indications of a change in the direction of its pro-
gress.   To avoid the centre, and get on the southern verge, the
commander may stand to the southward, during which the
cyclone may gain westing, and pass the meridian of the ship,
at which juncture the wind will be easterly; the course to the
south, provided the ship remains within the disc, may be con-
tinued until the wind   becomes N.E., when the body of the
storm is to the N.W. of her.

26.   While these manœuvres are in progress, great care
must be exercised, and a sharp look out kept for *the bend.*   If
upon standing to the S., when the earliest appearances of the
neighbourhood of the cyclone are recognized, the weather does
not improve, the hurricane is recurving, and a very slight
westing will bring the vessel again into the steady trades, and
fair weather; the ship in such a case, just grazes the verge of
the storm.   When the ship takes the cyclone at E.S.E., and
the commander,—apprehending the motion of the storm to be
W.S.W., waits until it gets westing, so that the verge may

leave the ship with an **E.N.E.** wind,—finds that the easterly wind not only *hangs*, but bad weather is rapidly increasing; another indication is afforded of the cyclone recurving. In this case, loss of time may involve loss of ship. The westing of the vessel is now of the utmost importance, to remain hove-to when the significant signs of the centre bearing down from the north are unmistakable, must expose the ship to all the fury of the gale, the best manœuvre appears to be, so to trim the vessel, that she may sail from the axis line towards the west, both ship and storm are then trending in opposite directions, which will the more quickly tend to extricate her.

27.   Returning to the consideration of the case, (sec. 25.) in which the commander waited until he found himself on the S.E. verge, and a little further westing of the storm would leave the ship no longer exposed to its influence; it must be borne in mind, that although he might thus with ease, escape its fury, it would at some part of its course *recurve*, and very probably, he would again encounter it: if, however, before his leaving the cyclone, the wind should continue to veer, the weather, instead of improving, should grow worse, and a northerly wind blow with increasing violence, then the commander could draw no other conclusion, but, that the hurricane had then arrived at the apex—the western-most point of its path—and was recurving, his object now would be, by waiting to allow it to attain sufficient southing, so that he might cross its wake, without deviating from his usual course.

28.   There are two or three points that require especial notice in these examples, the veering of the wind was S.E. E. N.E., *i.e.,* with the apparent course of the sun; the semi-circle in which the ship manœuvred, was the port, or left-hand semi-circle, and the octant in which the ship took the gale, was the most dangerous.   These facts furnish a general law, applicable to all storms in the Indian Ocean, viz. IN THE RIGHT

HAND, OR STARBOARD SEMI-CIRCLE, THE WIND HAULS AGAINST
THE SUN; AND IN THE PORT, OR LEFT HAND SEMI-CIRCLE WITH
IT; the most dangerous octant is in the port semi-circle, in ad-
vance of the centre, abutting on the axis line, and in the great
majority of cases, characterized by a S.E. wind, so that *before
recurving*, a S.E. hurricane wind is the most dangerous.

29.   A vessel, north of the axis line, has not near so much
to contend with, as one south of it: if she take the gale on the
N.W. margin, with the wind at S.W., by standing northward
she may rapidly extricate herself, especially if the gale be about
recurving; almost under any circumstances, by such a ma-
nœuvre, the centre of the storm and vessel, are rapidly parting
company.

30.   The rotation of the wind in a storm, violently agitates
the surface of the ocean, producing a swell or *storm wave*, this
wave is propagated in the same direction as the wind, charac-
terizing the margin to which the swell is a tangent. The *undu-
lations* thus rolling from the margin, both in advance and re-
gression of the storm itself, encounter each other and produce in
the area of intersection, *cross seas*, which are more or less danger-
ous, according as they are met with in advance or behind the
hurricane.   As the cyclone advances, a series of undulations
are thrown off to the right and left, which flow in the direc-
tion of the two radii of the storm, dividing its semi-circles into
quadrants.   It is easy to see that these undulations *fringe*
the storm's wake, they are found in fact to the right and left
of the path which the storm has described.

31.   In the left-hand or port semi-circle, in the northern
hemisphere, and in the right-hand or starboard semi-circle, in
the southern, a sea is given off which meets the undulations
flowing to the right and left of the storm's path, and produces
in the *left-hand side* of the storm's wake, in the *northern*
hemisphere, and in the *right-hand side*, in the southern

hemisphere, a tremendous pyramidal sea. When this cross turbulent sea is encountered, it is a pretty sure indication that the storm itself has passed the locality. A few examples in the southern hemisphere will illustrate the effect of the cross seas, according as they are met with, in advance, or on the right or left hand of the storm's path.

32. A vessel in the Indian Ocean meets with a cyclone wind at S. heralded by the significant meteorological signs, characterizing the approach of a hurricane, but has not experienced any remarkable disturbance of the nature of a cross sea. This is a very dangerous position, inasmuch that if the commander depend on the appearance of the sea, as an indication of the proximity of a hurricane; he may here be greatly mistaken. The wind, its hauling and meteorological accompaniments, are sure indications of the presence of a cyclone; and it may be added, that *the absence of a cross sea* is also an indication of the vessel being on the confines of the most dangerous octant.

Another vessel with the wind at N.W., experiences a mighty hubbub, she is involved in a turbulent pyramidal cross sea, and this is the greatest difficulty she has to encounter, the cyclone is leaving her in its wake, which is characterized on the starboard side, by a "heavy cross sea."

A third vessel experiences the easterly winds of a cyclone, free from a turbulent cross sea. As the wind veers to E.N.E. the cross sea overtakes her, and if she continue in the wake of the hurricane, she will continue to experience the cross sea, but not to the extent that a vessel in the starboard or opposite side of the wake will.

GREAT CIRCLE SAILING.

1. If, on a Mercator's Chart, any two places (not on the equator, or on the same meridian) be selected, we see that the shortest distance between them is a straight line, and providing no land intervene and the winds and currents are favourable for the purpose, the navigator has no occasion to change the course on which he starts, in order to sail from the one to the other.

2. On a terrestrial globe, apply a piece of thread (stretching it evenly) to the same two places, and it will then be seen, that the shortest distance between them is *not* on a straight line, but on a portion of a circle, and in order to arrive at either place from the other, by such a route, the course to be sailed must be *constantly varying*.

    (a.) When both places are on the equator, or on the same meridian, the track on the great circle and that on the rhumb line are the same, and the course will be N.,S.,E., or W., according to the relative position of the ports.

3. Now the Earth is an oblate spheroid, or sphere of revolution, and the small difference between the equatorial and polar diameters does not preclude our regarding it as a perfect sphere in numerous computations.

4. If a sphere be cut in any direction by a plane, the section must be a circle.

    (a.) If the plane pass through the centre of the sphere, we have a *Great Circle*, and the sphere is divided into two equal parts : the equator and meridians are examples.

    (b.) If the plane does not pass through the centre of the sphere, the section is a *Small Circle*, dividing the sphere unequally : take the parallels of latitude as examples.

5. Two great circles always intersect in two points, at the distance of a semicircle from each other.

    (a.) The equator, which is a great circle, bisects every

other great circle on the earth's surface, and there must necessarily be two points in every such circle, equi-distant from the equator, and at the same time furthest removed from it : each of these points is called "Vertex ;" and the "Latitude of Vertex," which is the highest latitude attained in sailing on a Great Circle, is the nearest approach to the elevated pole. The meridian cutting the great circle at right angles, and dividing it into quadrants, is called the "Meridian of Vertex;" and the "Longitude from Vertex" is the arc of the equator intercepted between the meridian of any place and the meridian of Vertex.

6. The arc of a great circle joining two points, is the shortest distance between them on the surface of a sphere.

(a.) The same great circle cannot be drawn through more than two points, selected at random on the surface of a sphere.

7. A spherical triangle is the portion of space on the surface of a sphere, included between three arcs of intersecting great circles. All the computations for Great Circle Sailing are performed by Spherical Trigonometry.

8. The configuration of the earth is truly represented on Mercator's chart only at the equator, every where else it is distorted : the great circle track between any two places, drawn on such a chart, instead of appearing (as it really is,) the shortest, would be represented as a curved line. It is impossible, under any circumstances, to sail a ship on the true great circle track, but a very close approximation may be made to it in some latitudes; and moreover a knowledge of Great Circle Sailing is very useful in all latitudes, for when adverse winds are encountered, it teaches on which tack to lay the ship, in order to arrive most speedily at her destination.

These few observations will suffice, since it is not required

to enter into calculations, and it is necessary to be provided
with Towson's "Tables to facilitate the Practice of Great
Circle Sailing," at the end of which will be found explanations
as to their use, as well as of the linear index, which accom-
panies them.

INSTRUCTIONS TO COMMANDERS AND MATES

FOR THE

STOWAGE OF MIXED CARGOES,

Prepared by HENRY C. CHAPMAN & Co. Agents for Lloyd's, Liverpool.

Approved and recommended by the Committee for

Managing the Affairs of Lloyd's.

I. Owners, Commanders, and Mates of ships, are con-
sidered in law in the same situation as common carriers, it is
therefore necessary that all due precautions be taken to re-
ceive and stow cargoes in good order, and deliver the same
in like good order.   The law holds the ship-owner liable for the
safe custody of the goods when properly and legally received
on board in good order, and for the "delivery," to parties
producing the bill of lading.   The captain's blank bill of
lading should be receipted by the warehouse keeper, or
person authorised to receive the contents.   Goods are not
unfrequently sent alongside in a damaged state, and letters of
indemnity given to the captain by the shippers for signing in
good order and condition ; this is nothing more or less than
conniving at fraud ; fine Goods are also often damaged in the
ship's hold, by lumpers, if permitted to use cotton hooks in
handling bales. All goods must be received on board according

to the custom of the port where the cargo is to be taken in; and the same custom will regulate the commencement of the responsibility of the master and owners.

2.—HEMP, FLAX, WOOL and COTTON, should be dunnaged 9 inches on the floors, and to the *upper part* of the *bilge*, the wing bales of the second tier kept 6 inches off the side at the lower corner, and 2½ inches at the sides. Sand or damp gravel ballast to be covered with boards. Pumps to be frequently sounded and attended to. *Sharp-bottomed ships one-third less dunnage in floor and bilges.* Avoid Horn Shavings as dunnage from Calcutta.

3.—All CORN, WHEAT, RICE, PEAS, BEANS, &c. when in bulk, to be stowed on a good high platform, or dunnage wood, of not less than 10 inches, and in the bilges 14 inches dunnage; the pumps and masts cased, to have strong bulkheads, good shifting boards, with feeders aud ventilators, and to have no admixture of other goods. Flat-floored, wall-sided ships should be fitted with bilge pumps. On no consideration must the staunchion under the beams be removed.

4.—OIL, WINE, SPIRITS, BEER, MOLASSES, TAR, &c. to be stowed bung up; to have good *cross beds* at the quarters, *(and not to trust to hanging beds,)* to be well chocked with wood, and allowed to stow three heights of pipes or butts, four heights of puncheons, and six heights of hogsheads or half-puncheons. All Moist Goods and Liquids, such as SALTED HIDES, Bales of BACON, BUTTER, LARD, GREASE, CASTOR OIL, &c. should not be stowed too near "Dry Goods," whose nature is to absorb moisture. Ship-owners have often to pay heavy damages for leakage in casks of Molasses, arising from stowing too many heights without an intervening platform or 'twixt decks. From Bengal, goods also are frequently damaged by Castor Oil.

5.—TEA and FLOUR, in barrels; FLAX, CLOVER and LINSEED, or RICE, in tierces; COFFEE and COCOA, in bags, should

always have 9 inches, at least, of good dunnage in the bottom, and 14 to the upper part of the bilges, with 2½ inches at the sides: allowed to stow six heights of tierces, and eight heights of barrels. All ships above 600 tons should have 'twixt decks or platforms laid for these cargoes, to ease the pressure—caulked 'twixt decks should have scuppers in the sides, and 2½ inches of dunnage laid athwart ship, and not fore-and-aft ways, when in bags or sacks: and when in boxes or casks not less than 1 inch. RICE from Calcutta is not unfrequently damaged by Indigo, for want of care in stowing.

6.—Entire cargoes of SUGAR, SALTPETRE, and GUANO, in bags, must have the dunnage carefully attended to, as laid down for other goods. TIMBER ships are better without 'twixt decks if loading all Timber or Deals Brown Sugar to be kept separate from white Sugar, and both kept from direct contact with Saltpetre.

7.—Pot and Pearl ASHES, TOBACCO, BARK, INDIGO, MADDERS, GUM, &c. whether in casks, cases, or bales, to be dunnaged in the bottom, and to the upper part of the bilges, at *least* 9 inches, and 2½ inches at the sides.

8.—MISCELLANEOUS Goods, such as boxes of CHEESE, kegs and tubs of LARD, or other small or slight-made packages, not intended for broken stowage, should be stowed by themselves, and dunnaged as other goods.

9.—Barrels of PROVISIONS, and TALLOW casks, allowed to stow six heights. All METALS should be stowed under, and separated from, goods liable to be damaged by contact.

10.—All MANUFACTURED Goods, also DRY HIDES, bales of SILK, or other valuable articles, should have 2½ inches of dunnage against the side, to preserve a water-course. Bundles of SHEET IRON, RODS, Pigs of COPPER or IRON, or any rough hard substance, should not be allowed to come in contact with bales or bags, or any soft packages liable to be chafed.

When Mats can be procured, they should be used at the sides for Silk, Tea, &c.

11.—TAR, TURPENTINE, ROSIN, &c. to have flat beds of wood under the quarters, of an inch thick, and allowed to stow six heights.

12.—Very frequent and serious loss falls on Merchants on the upper part of cargoes, particularly in vessels that bring Wheat, Corn, Tobacco, Oil Cake, &c. arising from vapour damage imbibed by Wheat, Flour, or other goods, stowed in the same vessel with Turpentine, or other strong-scented articles : the shippers are to blame for such negligence, for not making due enquiry before shipping.

13.—Ships laden with full cargoes of Coal, bound round Cape Horn or Cape of Good Hope, to be provided with approved ventilators, as a preventive against ignition.

14.—No vessel bound on any over-sea voyage, should on any account be loaded beyond that point of immersion which will present a clear side out of water, when upright, of three inches to every foot depth of hold, measured amidships, from the height of the deck at the side, to the water.

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NOTE.—Shippers abroad, when they know that their cargoes will be stowed properly, will give a preference, and at higher rates, to such commanders of ships as will undertake to guarantee the dunnage. The American ship-owners, in the stowage of mixed cargoes in large ships, have, from experience, discovered what " pressure" flour barrels, provision casks, &c. will bear, and so avoid reclamations for damage if otherwise properly stowed : hence, in large ships above 600 tons, with dimensions exceeding in length 4½ times the beam, and 21 feet depth of hold, orlop decks will come into general use, so as to relieve the pressure, by dividing a ship's hold, like a

warehouse, into stories. A large ship, called the Liverpool, which left New York in December last, with an entire cargo of flour, has never since been heard of; it is supposed the lower tiers of barrels gave way under the pressure, and the cargo having got loose, shifted in a gale of wind, and capsized the vessel.

Ships' cargoes, for Insurance, will also become a matter of special agreement between merchant and ship-owner, and merchant underwriters, and the premium vary according to the dunnage agreement. The stowage and dunnage must stand A 1, and is often of more importance than the class of the vessel, as experience has proved. When ships are chartered for a lump sum, the draft of water should be limited, as it not unfrequently happens that brokers insert a clause that coals are not to be considered as dead weight, in order to fill the ship up in case of goods falling short to make up the chartered freight.

All packages, bales, and cases, not weighing more than 25 cwt. to the cubic ton measurement, are designated as light freight.

CHARTER-PARTY.

CHARTER-PARTY is a contract by which a ship or part of a ship is hired for the conveyance of goods, on certain specified conditions, and it is not required to be drawn up in any precise form of words, which must be adapted to suit the wishes and intentions of the parties concerned, and the trade in which the vessel is to be employed.

In a vessel's *home* port, the charter-party is executed by

the owner or owners, and the freighter or his agent; but in a *foreign* port, it is executed by the master, or the owner's authorised agent, (if there be such,) and the freighter or his agent.

A charter-party executed by the master, at home, under the evidence of the expressed or implied assent of the owner; or when in a foreign port, and there is no evidence of fraud, is binding on the owner.

A charterer may load the vessel with his own goods, or with those of other parties ; or he may underlet the vessel to another, providing no clause in the charter-party prohibits him so doing.

Under the charter-party, the ship must be in every respect seaworthy, and in a fit condition to carry goods, and the owners are bound to prepare and furnish every thing necessary to commence and fulfil the voyage. The ship must also be properly dunnaged, according to the usages of the trade in which she is employed, or according to the nature of the cargo : and in stowing the cargo, the various goods must be arranged and placed in the most approved methods, to prevent damage.

Expedition is of the utmost importance in all commercial and maritime transactions, if therefore either party be not ready at the specified time, for the loading of the ship, the other is at liberty to seek another ship or cargo, and bring an action to recover the damages he has sustained by the non-performance of the contract.

If the charter-party specifies any particular route, or names several ports, and the order in which they are to be taken, the master must pursue that course, but without such special mention, they must be taken in geographical order, on the usual or shortest course. A deviation from the prescribed or usual course is justifiable, for the purpose of repairs

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rendered necessary by tempests, or accidents, to procure supplies, or to avoid an enemy; but the vessel must be detained no longer than is absolutely requisite, and the voyage afterwards continued from the port in which she had taken refuge.

For the purpose of loading and unloading the ship, a certain number of days, called *lay days*, are generally agreed upon; it should be specified whether these are working or running days; and in addition it may be stipulated that the freighter is at liberty to detain the vessel a further fixed time, on payment of a daily sum, as *demurrage*. Should the vessel be detained beyond both periods, the freighter is liable to an action for damages, although the delay may not be attributable to any fault on his part.

When no *lay days* are specified, the length of time for loading and unloading must be determined by the nature of the cargo, or the number of days usually allowed at the port.

As soon as the vessel has the full complement of cargo, and all things necessary are arranged, as clearing at the custom house, payment of port charges, &c. the voyage must be forthwith commenced, *weather* permitting.

The master must not take on board any contraband goods, or have in his possession any false or colourable papers, whereby the ship and cargo are rendered liable to seizure; but he must obtain all papers and documents which are necessary to protect the ship and cargo in all the countries to which he is trading.

In time of war, if there is any stipulation to sail with convoy, the master must repair to the place of rendezvous, in good time, and be careful to procure all the instructions issued by the commander of the convoy, as he is accounted answerable for all losses brought about by neglect in such a case.

By the terms of the charter-party, not to be held liable for injuries arising from "the act of God, and the Queen's enemies, &c." the master or owner is not responsible for damage arising from the sea and winds, unless such injury or damage was the result of negligence or imprudence.

If the master receive goods at the quay or beach, or send his boat for them, his responsibility commences with the *receipt* of them. With goods to be sent coastwise, the responsibility of the wharfinger ceases on delivering them upon the wharf.

When the charter-party names a full and complete cargo, the master must take on board as much as he can, with safety, and without injury to the ship; and the freighter is obliged to furnish the same, either of his own goods, or the goods of others.

If any clause of the charter-party is ambiguous, the interpretation should be liberal, or if the charter-party is silent in respect to any point, the usage of the trade in which the ship is employed, must be adopted.

FREIGHT,

Is the sum paid by any merchant or other persons hiring a ship, or part of a ship, for the hire of such ship or part, during a specified voyage, or for a certain fixed time·

Freight may be contracted to be paid by the voyage, by the month, or other time, or by the ton, and is usually fixed by the charter-party, or bill of lading; where no formal stipulations have been made, it would be due according to the custom of the trade in which the ship is employed.

As a general rule, no freight is due, unless the voyage has been performed, and the goods delivered at the port of destination, according to the contract; but with respect to

living animals, men or cattle, which may die on a voyage, it is ruled that freight is due for dead and living, if no stipulation has been made in respect to them; if however, the contract is for *transporting* them, no freight is due for those dying on the voyage, as the contract is not performed; on the other hand, if the agreement is for the *lading*, then freight is due for dead and living.

If the whole ship is hired, and the freight is to be paid as a gross sum, the whole freight is due, although the freighter does not fully load the ship; or when the freight is to be paid at so much per ton, and the contract is for a full cargo, freight will be due according to the *real burden* of the ship, although there may have been an error in the contract in describing the ship of less burden than she really is.

When freight is to be paid at a fixed sum for the whole voyage, the owners take on themselves the chance of the voyage being long or short; but when freight is to be paid at so much per month, or week of the voyage, the risk of the duration falls on the freighter, who must pay for the whole time occupied, commencing from the day the vessel breaks ground, whatever obstructions or delays may afterwards occur, provided they are not occasioned by the neglect or fault of the owners or master, until she arrive at the port of destination.

If freight is stipulated to be paid only on the delivery of the cargo, this must take place before the freight can be demanded.

If by the charter-party a ship is to sail from one port to another, and thence back to the first, the whole being one voyage, no freight is due unless the whole voyage has been performed, although the ship might have delivered her cargo at one port, and she is only lost on returning to the place whence she started; but if the outward and homeward

voyages are distinct, and the first only is performed, the ship being lost on the homeward voyage, freight is due for the first.

If the cargo or any portion of it is damaged, through the fault or negligence of the master or crew, the charterer is entitled to compensation, being the amount of depreciation in the value of the goods, less freight; if however, the damage arises from circumstances over which the master has no control, freight is due, and no compensation for damage is allowed.

The right of a merchant to abandon his goods for freight when they have been damaged, has never been claimed in Great Britain; no freight is due in the event of a total loss.

If a portion of a cargo has been thrown overboard for the preservation of a ship, and she afterwards arrive at the port of destination, the value of the rejected cargo is to be answered to the charterer by way of general average, and the value of the freight thereof allowed to the owner. If the master is compelled to sell a part of the cargo for supplies or repairs, the owner must pay to the merchant the market price the goods would have brought, at the place of destination.

If it is found that the ship is disabled and cannot proceed to the port of destination, and the master declines to tranship the cargo, and the merchant does not require him to do this, but accepts the goods at the intermediate port, then freight is due according to the proportion of the voyage performed; if the master provides another ship for the transmission of the goods, he will be entitled to the whole freight originally contracted for, although by the second conveyance, the goods may be carried for less than that freight; if the freighter will not consent to the goods being forwarded, the master

being ready to do so, he will be liable for the full freight of the whole voyage.

If a consignee receive goods in accordance with the usual bill of lading, he is liable for the freight; but a person acting as *agent* for the consigner, it being known to the master that he acts in that capacity, is not liable.

If a ship under a charter-party, is sold *before* the voyage commences, the purchaser is entitled to the charter, but if a vessel is sold *during* a voyage, the original owner is entitled to it.

When the time and manner of paying freight is mentioned in the charter-party, or in any other written contract, the stipulations must be respected.

A master cannot retain the cargo on board, until the freight is paid.

BILL OF LADING,

Is a formal receipt signed by the master of a ship, acknowledging that he has received on board, the goods specified on it, and binding himself (under certain exceptions,) to deliver them in like good order as received, at the place, and to the individual named in the bill, on the payment of the stipulated freight. The terms of the exceptions above mentioned, are as follows;—"the act of God, the Queen's enemies, fire, and all and every other dangers and accidents of the seas, rivers, and navigation, of whatever nature and kind soever, excepted," and in the case of ships homeward bound from the West Indies, which send their boats to fetch the cargo, there is further added, "save risk of boats, so far as ships are liable thereto."

The master should not sign bills of lading, until the goods are delivered, and on board, and he is satisfied of their condition.

When a ship is hired by a charter-party, the bills of lading are delivered by the master to the person to whom the ship is chartered, but in a *general* ship, (i. e. a ship in which goods of many different parties are laden,) each person sending goods on board, receives a bill of lading, for the same.

It is usual to make out three bills of lading, each of which must be stamped: one for the shipper, another one for the consignee or agent, or purchaser, (which is sent by post,) the third is retained by the master for his use and guidance.

Bills of lading are transferable by indorsation, and the master must deliver the goods to the holder of the bill, who has acquired a legal right to it.

INVOICES.—MANIFEST.

An invoice is a description of goods sold or consigned, with an account of the charges. A shipping or exportation invoice, gives an account of the goods, the names of the vessel and master, the port of destination, the name of the consignee, and a specification of the account on which the goods are sent.

A manifest is a document signed by the master at the place of lading, and sets forth the name and tonnage of the ship, the name of the master and of the place to which he belongs, and the place or places for which they are respectively destined, contains a particular account and description of all packages on board, with the marks and numbers thereon, the sorts of goods, the different kinds of each sort to the best of the master's knowledge, particulars of goods stowed loose,

the names of shippers and consignees, and all other particulars relating to the ship, her cargo, and her passengers.

BOTTOMRY.

A bottomry bond is a contract by which a ship is pledged, and made security for a debt, contracted with relation to it; it becomes repayable on the ship terminating the voyage successfully; if the ship is lost, the lender loses the money advanced, and thus having to sustain the hazard of the voyage, he is allowed a greater price or premium for his money, than the usual rate of interest acknowledged by law. Money so borrowed must be expended on necessaries for the ship, repairs and refitting her for the voyage.

If, on a voyage, two or more bottomry bonds be entered into, they take precedence in the reverse order, the last being first payable.

Money to be borrowed on bottomry, should always be advertised for, and the lowest offer of interest accepted.

Respondentia is a contract by which money is raised on the chance of the safe arrival of a ship's cargo.

Answers to the Exercises in Logarithms, &c.

1.	3·829561	3·857332	4·640581	4·601038	5·602060
	9·165244	7·810904	0·588160	1·255417	7·662758
2.	5·8672 +	6·6308 +	237·08 +	407·78 +	10016·37
	74·854 +	82·035 +	1259·7 +	1639·8 +	100340·4 +

3.	sine	9·867731	9·217122	8·504198
		9·978387	9·972463	8·246654
	cosine	9·907282	8·361681	8·246773
		9·972585	9·937470	9·505271
	tangent	9·613707	8·297036	10·109995
		9·879657	8·258262	10·348195

4.	cotangent	10·094133	9·783450	9·518992
		9·684753	10·793269	11·263849
	secant	10·028424	10·151822	10·503501
		10·059001	10·714159	10·104167
	cosecant	10·149446	10·025635	10·203770
		10·100598	10·061659	10·559516

5.	8° 43′ 6″	78° 8′ 50″	1° 39′ 39″	4° 1′ 28″
	77 14 19	15 31 22	41 12 21	84 40 38
	23 43 17	81 53 25	35 3 31	48 58 24
	61 3 33	7 34 15	76 40 15	88 20 53
	22 35 46	35 39 40	88 22 22	86 22 56
	50 57 26	60 13 52	1 57 4	5 43 39

6.   224632

7.   ·23105 +

8,   47·987 +

9.   3·8293 +

10.   ·036902 +

11.   240·29 +

12.   1850

13.   ·086956 +

14.   1·70648 –

15.   884403.6 +

16.   ·129996

17.	2116	8836	[·026569	·00005625
18.	103823	250047	·001295 +	·0000006382 +
19.	69·253	864·25 +	·80436 +	
20.	33·163	39·611 +	[·91113	

21.   £113. 2. 11¼

22.   £225. 18.

23.   4s. 8½d.$\frac{2}{5}$

24.   £7. 10s. 1¼d.$\frac{6}{35}$

9

Answers to the Day's Works.

1. Diff. lat. 128·5′S. : dep. 11·8′E. : Course S.5°E. dist. 129′
   Lat. in 27° 48′S. : diff. long. 13′E, : Long. in. 45° 15′E.
2. Diff. lat. 22·6′S. : dep. 3·3′E. : Course S. 8°E. dist. 23′
   Lat. in 37° 58′S. : diff. long. 4′ : Long. in 150° 9′E.
3. Diff. lat. 60·8′S. : dep. 66·8′W. : Course S.48°W. dist. 91′
   Lat. in 3° 23′N. : diff. long. 67′W. : Long, in 8° 53′W.
4. Diff. lat. 25·9′N. : dep. 16·4′W. : Course N.33°W. dist. 31′
   Lat. in 34°8. : diff. long. 20′W. : Long. in 172° 18′E.
5. Diff. lat. 31·2′S. : dep. 10·7′E. : Course S.19°E. dist. 33′
   Lat. in 26° 10′S. : diff. long. 12′ : Long. in 45° 19′.
6. Diff. lat. 16′S. : dep. 159·2′W : Course S.84½°W. dist. 160′
   Lat. in 34° 46′S : diff. long. 191′ : Long. in 169° 38′E.

Answers to the Exercises for the Ordinary Examination.

PAPER I.

1. 10,010,010
2. 33972
3. 845544960 inches
4. 90660004
5. Dec. 0° 1′ 0″N. Lat. 27° 40′ 35″N.
6. A.T.G. 5d. 15h. 25m. Dec. 22° 32′S. Mer. zen. dist. 39°12′16″S.
   Lat. 61° 45′ 16″S.
7. M.T.G. 5d. 18h. 57m. 30s. Dec. 22° 32′S. Eq. time 6m. 3s.
   M.T.S. 6d. 3h. 43m. 56s. Long. 131° 36′ 30″ E.
8. A.T.G. 6d. 1h. 36m. Dec. 22°30′S. True ampl. E. 23°23′55″S.
   Variation 5° 3′ 55″E.
9. M.T.G. 6d. 8h. 8m. Dec. 22°28′S. True azim. N.75°49′34″W
   Variation, 21° 20′ 26″E.
10. 8h 10m. a.m. 8h 36m. p.m.
11. Course N.56° 9′ 50″ W. Dist. 6618 miles.
12. N. 55°E. : S. 71° 30′E. : S. 17°30′W. : N. 10° 5″W. :
    N. 78° 10′E.

PAPER II.

1. 909,040
2. 239590
3. 311592960 ounces
4. 60704090
5. Dec. 6″N.   Lat. 39° 39′ 14″S.
6. A. T. G. 5d 1h.   Dec. 6° 2′ 17″S.   Mer. zen. dist. 39° 42′ 3″N.
   Lat. 33° 39′ 46″N.
7. M. T. G 27d 23h 26m.   Dec. 2° 58′N.   Eq. time 5m 13 ·5s.
   M. T. S. 28d 3h 49m 38s.   Long. 65° 54′ 30″E.
8. A. T. G. 30d 19h 38m.   Dec. 4° 4′ 24″N.   True amplitude,
   W. 4° 5′ 56″N. Variation, 7° 45′ 56″E.
9. M. T. G. 26d 0h 30m.   Dec. 2° 12′ 4″N.   True azimuth,
   S. 57° 12′ 24″E. Variation, 16° 42′ 24″W.
10. Course S. 73° 24′ 4″W.   Dist. 2559 miles.
11, 5h 33m. a. m.   5h 53m. p. m.
12. S. 81° 10′E.   S. 61°55′E.   N. 24°10′W.   S. 59°40′W.

PAPER III.

1. 104,090,009
2. 185627
3. 12934753920 barleycorns
4. 82090007
5. Dec. 6° 21′ 26″N.   Lat. 35° 38′ 36″S.
6. A. T. G. 20d 23h 17m.   Dec. 11° 50′N.   Mer. zen. dist.
   28° 2′ 52″N.   Lat. 39° 52′ 52″N.
7. M. T. G. 15d 6h 6m.   Dec. 9° 50′ 31″N.   Eq. time 1s.
   M. T. S. 14d 20h 38m 11s.   Long. 141°57′15″W.
8. A. T. G. 29d 2h 36m.   Dec. 14° 29′N.   True amplitude
   E. 16° 2′ 36″N. Variation 8° 12′ 24″E.
9. M. T. G. 24d 23h 19m 30s.   Dec. 13° 10′N.   True azimuth
   N. 41° 51′ 30″W. Variation 34° 41′ 30″W.
10, 9h 55m a. m.   10h 13m p. m.
11. Course N. 66° 15′ 2″W.   Dist. 3153 miles
12. S. 38°W.   N. 49° 50′ W.   N. 74° 20′W.   S. 3°E.

PAPER IV.

1. 90,204,050
2. 1029875
3. 25485917760000 seconds
4. 807098000
5. Dec. 0° 8′ 14″N.   Lat. 48° 9′ 22″S.
6. A. T. G. 10d 1h 30m.   Dec. 22° 15′ 41″N.   Mer. zen. dist. 29° 27′ 29″N.   Lat. 51° 43′ 10″N.
7. M. T. G. 28d 22h 6m.   Dec. 18° 48′ 46″N.   Eq. time 6m 11s. M. T. S. 28d 21h 3m 34s.   Long. 15° 36′ 30″W.
8. A. T. G. 28d 1h 4m 30s.   Dec. 19° 1′N.   True amplitude E. 28° 37′ 6″N.   Variation 14° 2′ 54″E.
9. M. T. G. 31d 1h 6m 30s.   Dec. 18° 18′N.   True azimuth S. 78° 29′ 36″E.   Variation 0° 9′ 36″W.
10. Course N. 63° 59′ 6″E.   Dist. 6935 miles
11. 0h 29m a. m.   1h 3m p. m.
12. S. 81° 10′ W.   N. 67° 10′ E.   S. 48° 48′ W.   N. 78° 10′ E.

PAPER V.

1. 100,060,409
2. 760715
3. 48777442560 inches
4. $6409010178\frac{7598}{8600}$
5. Dec. 0° 3′ 18″N.   Lat. 6° 10′ 57″N.
6. A. T. G. 15d 14h 30m.   Dec. 2° 49′ 50″N.   Mer. zen. dist. 45° 25′ 40″S.   Lat. 42° 35′ 50″S.
7. M. T. G. 1d 0h 19m 30s.   Dec. 8° 19′N.   Eq. time 5s. M. T. S. 1d 4h 4m 40s.   Long. 56° 17′ 30″E.
8. A.T.G. Sept.30th, 19h 15m.   Dec. 3° 5′ 10″S.   True amplitude E. 4° 32′ 30″S.   Variation 26° 27′ 30″W.
9. M. T. G. 2d 0h 30m.   Dec. 7° 57′N.   True azimuth N. 51° 49′ 20″W.   Variation 30° 39′ 20″W.
10. 10h 18m a. m.   11h 5m p. m.
11. Course S. 57° 12′ 46″E.   Dist. 5941 miles
12. S. 70° 25′ W.   S. 6° 55′ W.   S. 66° 42′ 30″E.   N. 55° 52′ 30″W.

PAPER VI.

1. 900,002,001
2. 1005721
3. 8793360000″
4. 2000007
5. Dec, 0° 2′ 37″N.   Lat. 32° 24′ 29″S.
6. A. T. G. 15d 22h.   Dec. 23° 19′ 53″S.   Mer. zen. dist.
   57° 7′ 34″N.   Lat. 33° 47′ 41″N.
7. M. T. G. 15d 6h 15m.   Dec. 23° 18′S.   Eq. time 4m 32·3s
   M. T. S. 14d 20h 37m 7s.   Long. 144° 28′ 15″W.
8. A. T. G. 15d 23h.   Dec. 23° 20′S.   True amplitude
   W. 31° 10′ 5″S.   Variation 3° 39′ 35″W.
9. M. T. G. 16d 6h.   Dec. 23° 20′ 44″S.   True azimuth
   N. 83° 21′ 28″E.   Variation 9° 21′ 28″E.
10. 11h 46m a. m.   No p. m. tide
11. Course S. 43° 37′ 35″E.   Dist. 6514 miles
12. S. 76° 20′E.   N. 61° 5′E.   N. 23° 6′S.   N. 24° 10′W.

Answers to the Exercises for the Extra Examination.

PAPER I.

1. Sid. time of observation 7h 9m 10·56s.   1st cor. + 57″
   2nd cor. + 1′ 34″   3rd cor. + 1′ 32″   Lat. 54°49′35″N.
2. ☾'s dec. 0° 5′ 40″S   Lat. 38° 55′ 12″N.
3. Lat. 30° 2′ N.
4. M. T. at Gr. by Lunar, Jan. 7d 6h.   M. T. at ship 7d 4h 12m
   32s.   Long. 26° 52′W.   Error of Chron. 20m. 2s. fast.
5. S. 71°W.   91 miles

PAPER II.

1. Sid. time of observation 19h 7m 4·47s.   1st cor. − 9″
   2nd cor. + 2′   3rd cor. + 53″   Lat. 60° 55′ 2″ N.
2. ☾'s dec. 10° 3′ 1″S.   Lat. 33° 54′ 4″N.
3. Lat. 52° 58′ 47″S.
4. M. T. at Gr. by Lunar, Feb. 6d 6h 48m 16s.   M. T. at ship,
   6d 5h 20m 46s.   Long. 22°W.
5. N. 35°W. 107 miles

PAPER III.

1.   Sid. time of observation 14h 34m 31·43s   1st cor. +1° 21′ 8″
    2nd cor. +11″   3rd cor. +1′ 33″   Lat. 51° 14′ 22″N.
2.   ☾'s dec. 6° 4′ 5″S   Lat. 54° 58′ 23″S.
3.   Lat. 46° 59′N.
4.   M. T. at Gr. by Lunar, May 9d 15h 46m 48s   M. T. at ship,
    9d 8h 35m 56s   Long. 107°43′W.
5.   W. by S. 60 miles

PAPER IV.

1.   Sid. time of observation 3h 5m 11·57s.   1st cor. —1° 16′ 3″
    2nd cor. +16″   3rd cor. +49″   Lat. 43° 49′ 21″N.
2.   ☾'s dec. 15° 35′ 39″N.   Lat. 13° 6′ 31″S.
3.   Lat. 11° 53′ S.
4.   M. T. at Gr. by Lunar, Feb. 18d 13h 19m 56s   M. T. at ship,
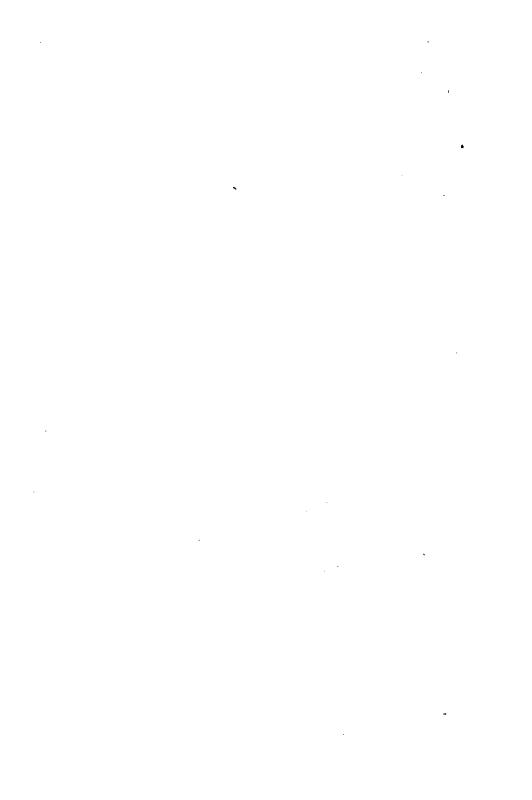   18d 21h   Long. 115° 1′E.   Error of chron. 17m. 6s. slow.
5.   S. 6°W. 64 miles

PAPER V.

1.   Lat. 35° 42′ 48″N.
2.   Lat. 47° 25′ 37″S.
3.   ♃'s dec. 22° 19′ 22″S   Lat. 7° 13′ 23″N.
4.   ☉'s mer. dist. 3h 27m. 20s.   ☾'s mer. dist. 44m. 38·4s.   ☉'s dec.
    12° 30′N.   ☾'s dec. 9° 45′ 20″S.   ☾'s R.A. 23h. 20m. 11·43s
    ☉'s true alt. 36° 54′ 55″   ☉'s app. alt. 36° 56′ 4″   ☾'s true
    alt. 39° 1′ 10″   ☾'s app. alt. 38° 17′ 14″
5.   Sid. T. of obs. 21h. 11m. 36·05s.   ✳ R. A. 16h. 20m. 28·51s.
    ✳ dec. 26° 6′ 21″S.   ☾'s R.A. 21h. 48m. 0·19s.   ☾'s dec.
    18° 45′ 16″S.   ✳ app. alt. 28° 20′ 25″   ☾'s app. alt.
    70° 30′ 20″   True dist. 74° 50′ 17″   Long. 18°E.
6.   Jupiter's app. alt. 22° 6′   ☾'s app. alt. 56° 0′ 43″   True dist.
    79° 48′ 41″   Long. 134°W.
7.   Equat. equal alt. —2·56s. Chron. fast on app. T. 6h. 35m. 47·4s.
    Chron. fast on mean time 6h. 35m. 38·5s.
8.   Lat. 6° 4′S.

PAPER VI.

1. ♃'s dec. 22°5′25″S.   Lat. 42° 29′ 52″S.

2. Lat. 20° 58′ 39″S.

3. Lat. 56° 5′ 49″N.

4. True dist. 60° 20′ 2″   Chron. slow on M. T. at Green. 48m. 11s, Long. 67° 15′W.

5. ✳'s app. alt. 23° 12′ 6″   ☾'s app. alt. 57° 43′ 40″   True dist. 60° 6′ 50″   Long. 171° 6′ E.

6. Equat. equal alt. + 5·86s. Chron. slow on app. time 2h. 38m. 10s. Chron. slow on M.T. 2h. 30m. 30·6s.

7. Equat. equal alt. —9·84s.   Chron. slow for apparent noon 2h. 34m. 19·8s.   Chron. slow for mean noon 2h. 23m. 12·8s.

8. ' Lat. 9° 26′N.